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# MACHINERY

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LANDIS  
WORLD'S

# THREAD ENGINEERING DEVELOPMENTS FOR DEFENSE PRODUCTION

MACHINE  
LARGEST

## *Landmaco Machine Adapted For Threading U. S. Navy Rockets*

**A** LANDMACO Threading Machine, through special tooling devised by our Engineering Department, was recently adapted for use by a southwestern manufacturer for the precision threading of 5" Mark 6 Navy Rockets.

### **JOB REQUIREMENTS:**

Specifications required the generation of  $4\frac{3}{4}$ "

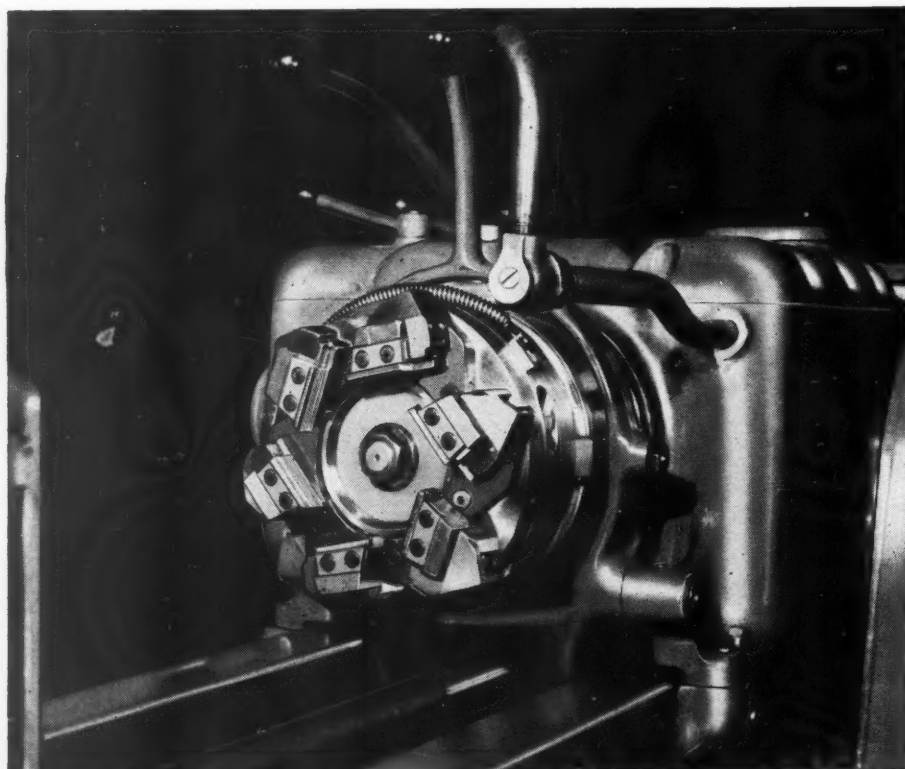
diameter 12-pitch threads on the rocket head. As a result of the design of the rocket this threading operation had been a trouble spot in the manufacturing process.

Concentricity limits had to be held between thread and the section of the workpiece projecting in front of the thread. It had been difficult to main-

tain the exact tolerances required. One of the problems arose from the fact that the diameter of the forepart of the projection was larger than the root diameter of the thread. Detailed specifications and engineering drawings of the rocket head are not available for security reasons.

### **THREADING EQUIPMENT USED:**

Today precision threads are being cut on these rocket heads at high production rates, and the threads are held to close concentricity. A battery of three  $2\frac{1}{2}$ " Single Head LANDMACO



Leadscrew Threading Machines are used in the operations, each equipped with Special Tooling devised to meet the problems of this specific job.

#### SPECIAL TOOLING:

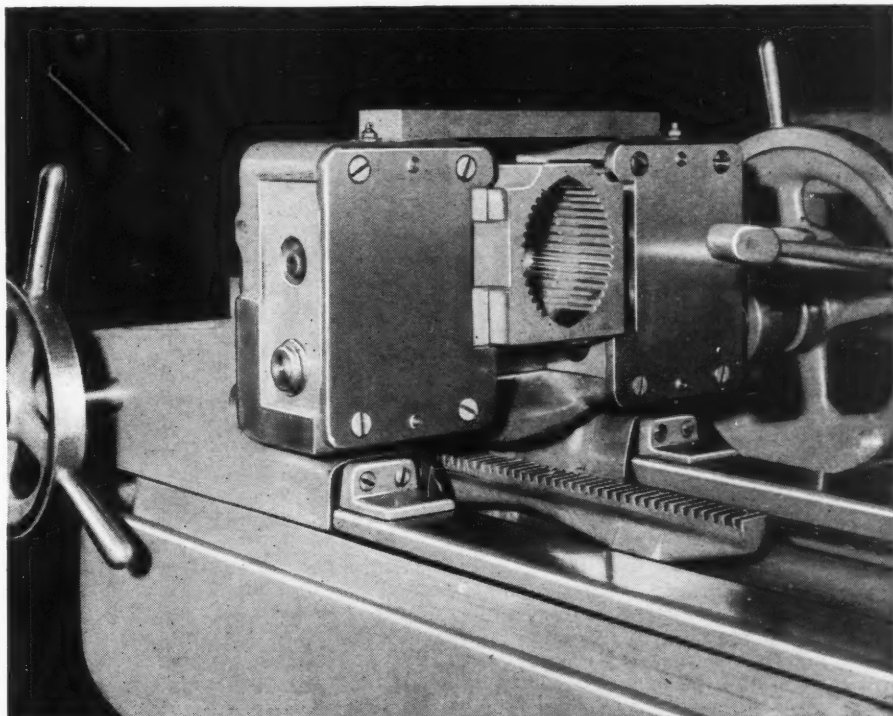
1. *40RX LANCO Head.* This head features the use of six chasers, thus distributing the cutting strains over a larger number of threading tools. This results in a finer thread finish and longer tool life.

2. *Receding-type centering pilot.* The bore of each head is fitted with this pilot to maintain close concentricity. The pilot is slightly tapered so that it fits over the front end of the rocket head. Thus, before the work is gripped in the vise, it is engaged by the centering pilot while the head is open. A relief between the start of the thread and the larger diameter of the projection provides the clearance necessary for the head to close.

3. *Heavy-duty Vise.* It is adjustable both vertically and horizontally for easy operation. A metal tie is doweled and bolted to the top of the vise as reinforcement to assure maximum strength and rigidity. The vise has round, serrated grips, precision-ground to insure uniform gripping surfaces.

4. *Hammer-blow hand-wheel.* Reduces operator-fatigue to a minimum, and precludes slippage of the workpiece and facilitates its removal.

5. *Hand-operated work-stop.* This assures maximum chucking efficiency and uniformity of thread length. The work stop also eliminates one



cause of die breakage in that it accurately positions the work axially in the vise to prevent the chasers from striking against work shoulders.

This special adaptation of a standard LAND-MACO Machine illustrates the utility of Landis Threading Equipment in the growing expansion of ordnance production. Landis Engineers have helped many manufacturers, just as this one, with their problems in thread production by recommending the proper equipment, and process for the job, and by devising special tooling for the job's unusual requirements. Perhaps your current thread production problem may be solved as successfully as this.



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# Instrument

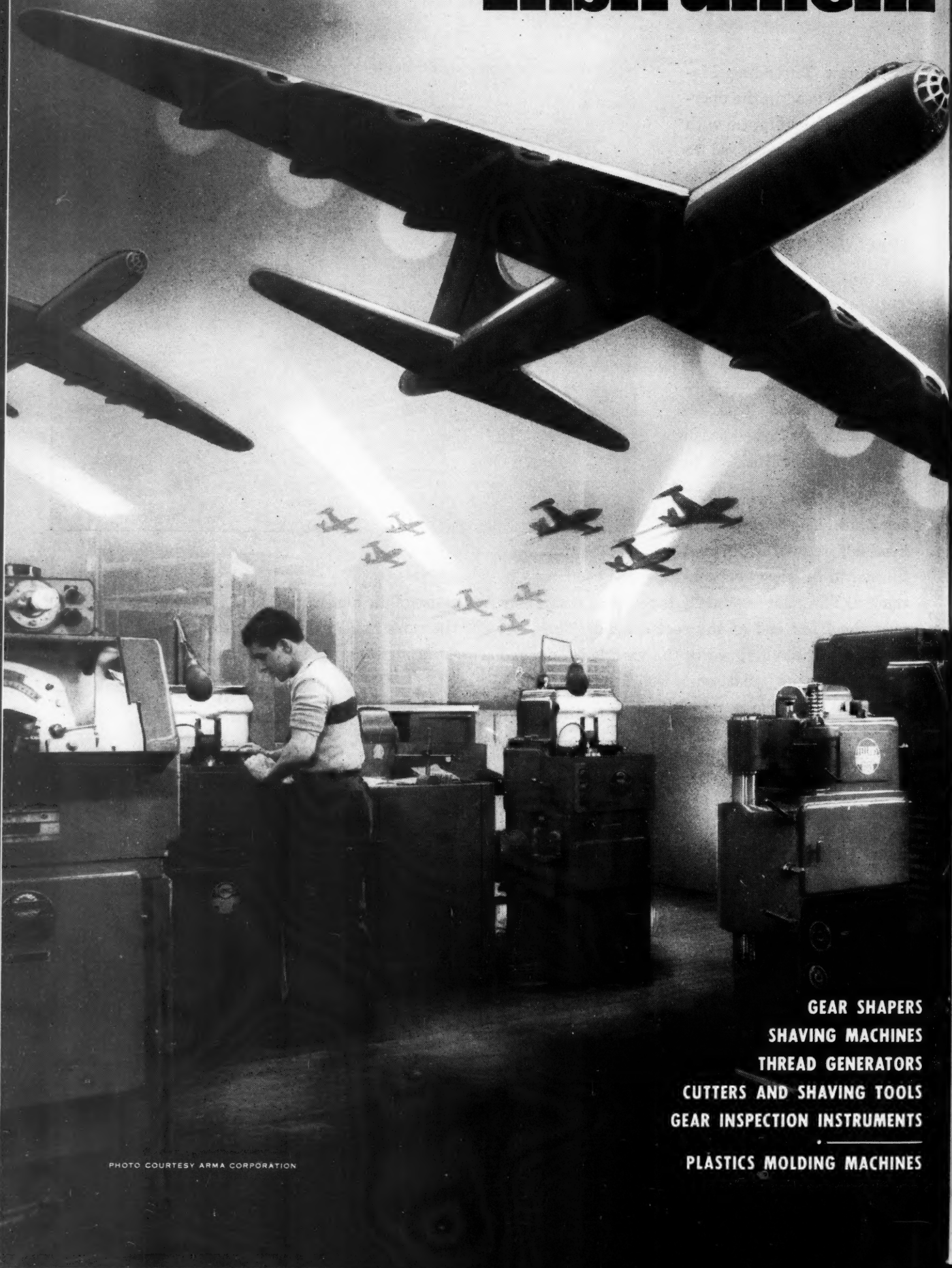


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GEAR SHAPERS  
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THREAD GENERATORS  
CUTTERS AND SHAVING TOOLS  
GEAR INSPECTION INSTRUMENTS  
PLASTICS MOLDING MACHINES



By LORING F. OVERMAN

## Washington Tells Machinery Industry of Defense Needs Machinery Industry Tells Washington How to Get Action

**T**HINGS have reached the show-down stage between Washington and the machinery industries. Washington has conceded that it takes more than a Defense Mobilizer or a National Production Administration to tool up the nation's defense machine. It takes capital, the right business atmosphere, materials and manpower, and the green light to go ahead and do the things that management knows must be done in order to get production.

Mobilizer Charles E. Wilson knows all these things, of course. But it is already painfully apparent that coaxing a nation to change its way of life is quite a different thing from directing a single company—however huge—to accomplish a given goal.

In mid-July, Mobilizer Wilson issued his now famous directive intended "to enable metal-working tool builders to devote their entire energies to production, to provide them with genuine incentives for all-out production, and to channel their production best to meet defense requirements for ourselves and our allies."

As one of the first direct results of the Wilson directive, a new Metal-Working Equipment Division was created within the National Production Authority. Heading the division is H. L. Tigges, executive vice-president of Baker Bros., Toledo, Ohio. He is past-president and a director of the American Society of Tool Engineers, and is also a member of the American Ordnance Association.

Creation of Mr. Tigges' new division within the Industrial and Agricultural Equipment Bureau of NPA required several other changes among the agency's machinery men. Walter E. Schirmer, of Buchanan, Mich., replaced Mr. Tigges as head of the General Industrial Equipment Division; and M. H. Garber, of Lorain, Ohio, replaced Neal Higgins, of Chicago, as director of the Construction Machinery Division. Mr. Higgins returned to his executive position with the International Harvester Co.

Mr. Schirmer is on leave from his position as vice-president of the

Clark Equipment Co., while Mr. Garber is on leave from his post as sales director of the Thew Shovel Co. During World War II, Mr. Garber was director of the Construction Machinery Division of the War Production Board.

The new division will handle Controlled Materials paper work for the metal-working machinery industry, and will be responsible for the proposed expansion program of the industry. It will also be responsible for allocation of materials to the machine tools industry, and will administer the pool orders under which advance orders are given to the industry by the General Services Administration.

The Mobilizer's directive and NPA's reorganization were accompanied on July 23 by an Industry Advisory Committee session, at which members of the industry had their say. After being told by NPA that production of machine tools will have to be increased sharply to meet anticipated needs of the mobilization program, members of the Industry Advisory Committee pointed out what would have to be done. They said that even if it were possible to double their output in the next twelve months, the industry would not be able to keep up with the schedule set for it in the tentative estimates of probable requirements. Expansion of the industry would depend on the following requirements:

1. Super priorities for materials, facilities, and tools.
2. More skilled labor. Assurances that war plants will not proselyte the skilled employes of machine tool plants.
3. Adequate financing for expansion and to provide working capital.

Committee members explained that the present system of tax amortization does not fit the needs of machine tool builders. The system permits accelerated amortization up to 75 per cent of the cost of emergency plant facilities, compared with the 100 per cent amortization allowed in World War II.

Some form of increased depreciation for tax purposes on plant equipment used in two- and three-shift operations was urged. The committee also observed that sub-contracting is not the solution to the problem, since less than one-third of the needed machine tool output could be obtained through even the most favorable sub-contracting arrangements.

Objections were raised by committee members to proposed Government plans to charge 4 per cent interest for advance Government financing of pool orders. Recalling that such advances were made during World War II without interest, it was pointed out that the major incentive for accepting pool orders was the availability of a cash advance to finance production.

Washington certainly knows, beyond a doubt, that the makings of machine defense lie only in machines to make machines. To help the cause along while new machines are in the making, the Government is tapping its reserves of machine tools and making them available to defense production contractors. The Munitions Board, immediately following the Wilson directive, approved the withdrawal, if needed, of industrial machinery and machine tools from the National and Departmental Equipment Reserve for distribution from central locations by the Army, Navy, and Air Force.

The Air Force Materiel Command followed up the order by inviting Air Force contractors to borrow needed tools from machine tool storage sites at Marietta, Ga., and Omaha, Neb. The Industrial Equipment Section of the Air Force Materiel Command has been housekeeper for vast quantities of high-production machine tools at the two sites since World War II. The Munitions Board's announcement of permission to withdraw machine tools from the reserve in appropriate cases stated that these machines will be used in preference to buying new equipment to meet current production needs of the Armed Forces.



# How to Take Chance Out of Today's Alloy Buying

Here's a spark tester checking bars of Ryerson alloy steel. By reading the spark pattern thrown off when each bar is touched with this whirling, abrasive wheel, the tester determines the steel's analysis. In this way he verifies quality—guards against mixed steels.

Spark testing is only one of many steps in the Ryerson Certified Steel Plan for safer alloy buying—a plan especially important to you today, while restrictions are enforcing the use of leaner alloys with unfamiliar heat treatment response.

We also put every heat of Ryerson alloy steel through four separate hardenability tests, carefully recording the results on a Ryerson Alloy Certificate which goes with the steel. These tests enable you to buy Ryerson alloys on the basis of hardenability as well as analysis—the safest way to buy under today's changing conditions. And the recorded test results safely guide your heat treatment.

So play safe. Order from Ryerson where you can specify hardenability and be doubly sure. Stocks are out of balance from a size standpoint, but in all probability we can take care of your requirements.

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## *A Potential Reservoir of Manpower*

ONE of the deterrents to early culmination of the national defense program is the increasing scarcity of labor. The June reports of state employment services were to the effect that industrial concerns had a desperate need for over 64,000 skilled employes—mainly engineers, mechanical draftsmen, toolmakers, and machinists. To meet this situation, government officials have at long last given recognition to the desirability of deferring skilled help from service in the armed forces, and they are making a special effort to solve the manpower problems of such vital industries as the machine tool industry.

Skilled men cannot be trained overnight—it takes years to learn the ramifications of a trade or profession. However, men can be taught to operate one type of machine in a comparatively short length of time or to perform inspection, welding, and similar operations. Detail work being done by skilled men can often be handled by men given a short training and the skilled personnel released for the really important aspects of their work.

The question is where to obtain an adequate supply of help even though unskilled. A reservoir, virtually untapped, exists in the ranks of the physically handicapped. It is for this reason that President Truman has designated October 7 to 13

to be "National Employ the Physically Handicapped Week."

Quite a number of industrial concerns have made it a regular practice to include a percentage of physically handicapped among their employes. In fact, the Ford Motor Co. for the last thirty years has followed the rule of employing 10 per cent physically handicapped persons in all plants of the company. An article describing the beneficial results to Ford from this practice appeared in the April, 1944, number of MACHINERY; at that time there were over 11,000 handicapped workers in the River Rouge plant alone.

National surveys have shown the work performance of physically handicapped persons in both heavy and light industries to be uniformly satisfactory, provided the handicapped have been properly placed. They are excellent producers, safe workers, and stay on the job. In hiring this type of personnel, the manufacturer should not feel that he is extending charity, because invariably he is repaid with industry and loyalty.

Manufacturers should investigate all possibilities in their plants for hiring the deaf and the blind, the paralytic and the epileptic, and those who have lost limbs. After all, few jobs in any shop or office require physical perfection!

*Charles O. Herb*

EDITOR

# Here's what metal working management will want to know about Microcarb Control

**N**OTHING else can do what Microcarb does in controlling the carburization of steel parts. Gears, shafts, cams, bearings and all the other items which owe some of their high quality and low cost to the carburizing process can now be made even better—and possibly at even lower cost.

The cause of such improvement is simply that Microcarb measures directly the carburizing "strength" of the furnace gases which supply carbon to the work being processed.

Heretofore many carburizing equipments have measured the amount of carbonaceous material fed into the furnace, but none has **directly** measured the active carbon in the hot furnace gas. For a comparison, think of heating your home by putting fuel in the furnace, without a thermometer to tell the temperature. Keeping your home at the same temperature day in and day out would then be an art rather than a science; some one person's judgment would have to be accepted, but there'd be no check. The comparable condition has heretofore been quite common in carburizing operations, everywhere.

Microcarb ends that uncertainty; it measures and controls carbon directly. Heat-treaters simply set the Microcarb Controller at 90 if they wish to carburize to ninety carbon. "The carbon you set is the carbon you get".

The "reason why" for Microcarb is its carbon de-

tecting element. This invention, called a Carbohm, is an engineering rarity—a truly new device for sensing a change in its surroundings.

Basically, a Carbohm is a wire, made of an alloy which will either absorb carbon from the furnace atmosphere, or lose it to the atmosphere, until it and the atmosphere are in equilibrium, carbon-wise.

With every change in the wire's carbon content, there's a corresponding change in its electrical resistance. The two Microcarb instruments — Controller and Carbon Recorder—translate this resistance directly into terms of percent carbon, control on that basis and record the result.

Only Homocarb carburizing equipment of our new Series H can be used with Microcarb, because the furnace and its temperature control must be designed to meet the needs of atmosphere regulation. Specific features are a soundly designed electric furnace with solid-bottom retort, improved fan housing and work support, and aerodynamically designed discharge jets. Micromax temperature control of the Duration-Adjusting Type is included.

## Microcarb is many things to many men, especially in defense work.

**To top management,** Microcarb means better competitive position (for the individual company) quality-wise and possibly cost-wise. Also, it meets the usual desire for process control which is fully automatic.

**To production executives,** Microcarb means closer following of production schedules, because carburizing speeds and results are definitely more predictable than ever before.

**To personnel executives,** Microcarb means cleaner, more attractive working conditions. And, if the heat-treat uses incentive pay, Microcarb helps heat-treaters increase their earnings, because it makes

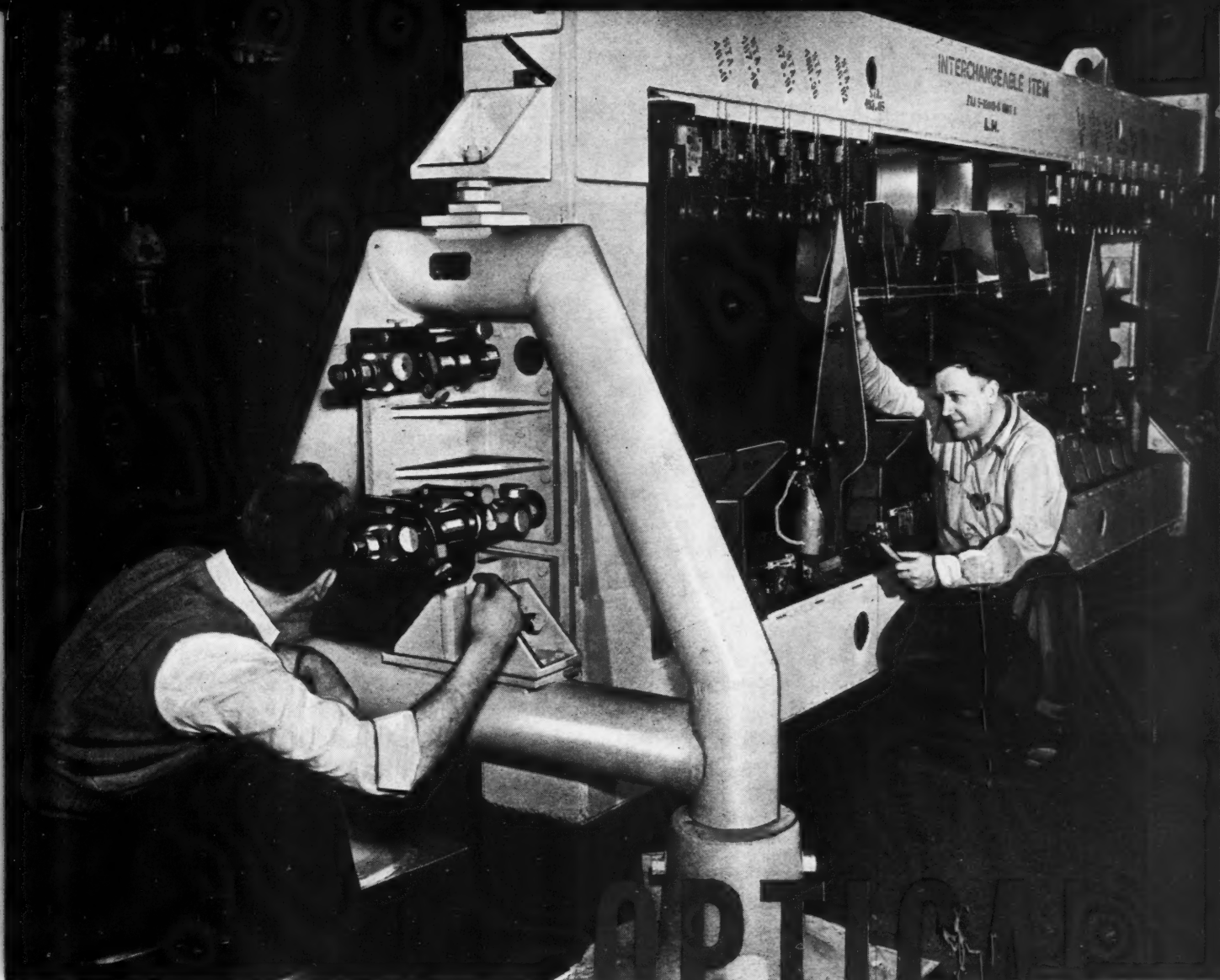
it easier for them to apply their skill and therefore increase their productivity.

**To metallurgists,** Microcarb means some or all of the above advantages, plus a tightening of technique such as every technician likes. "New" or hard-to-handle steels hold fewer puzzles. Standard steels emerge with closer specifications. The heat-treat takes another long step toward becoming a manufacturing laboratory.

Let us send you further facts about this new Microcarb Control. Ask our nearest office, or 4921 Stenton Ave., Phila. 44, Pa.



Jrl. Ad. TD4-623(4)



By B. K. BUCEY  
Tool Design Manager  
Boeing Airplane Co.  
Seattle, Wash.

# OPTICAL TOOLING

**INSURES AIRCRAFT ACCURACY**

**C**OOPERATION between the United States Air Force, aircraft manufacturers, and instrument suppliers has resulted in the development of an important new optical tooling system, which permits the rapid manufacture of more accurate airframe fixtures, with appreciable reductions in cost. The system is based upon the use of a precision alignment telescope and an illuminated glass graticule or target, both of which are held in spherical mounts that can quickly be located on mounting bases fastened permanently to the ends of the fixture.

A highly accurate optical reference line is established through the telescope by focussing it upon the target. This direct line of sight, or additional lines of sight established in relation to it, can be used instead of physical surfaces, wires, plumb bobs, transits, or levels for accurately aligning and checking fittings on the fixture. For this purpose, intermediate target plugs are mounted in the fittings. If the fitting has to be placed perpendicular to the line of sight, a collimator instrument is used in place of the conventional target. The collimator has a built-in

light source and two built-in targets through which displacement and tilt—with relation to the optical reference line—can be observed separately, in one setting, by looking through the telescope.

It has been estimated that optical tooling, as applied in the Seattle and Wichita plants of the Boeing Airplane Co., permits an accuracy five times greater, in measuring displacement, and ten times greater, in measuring tilt, than is possible with the previous method of employing tripod-mounted surveyor's transits and levels. While such transits and levels are, of course, precision instruments, an accuracy of about  $\pm 0.005$  inch was the best obtainable in such applications. This was primarily due to the fact that the reference plane provided by the transit and level was separate from the fixture on which the measurements were to be made.

The transit had to be set up about 18 inches to one side of the fixture and 8 feet behind it, so that the telescope could be focussed on all points between the ends of the fixture. Adjustment was then made so that swinging of the telescope established a vertical plane just to one side of the fixture and parallel with the center line. The level, on the other hand, had to be placed about 2 feet to one side—midway between the ends of the fixture—and it was adjusted to establish a horizontal plane. With these two

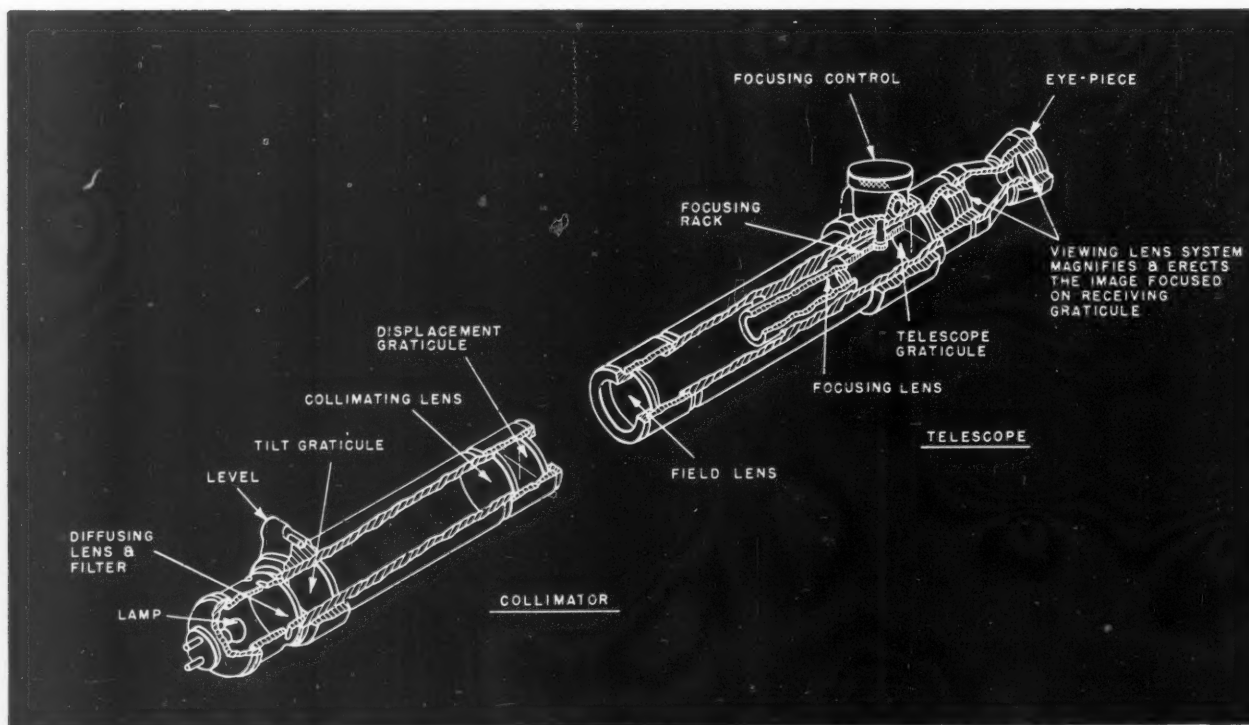
planes as references, measuring rods and rules were used to locate parts of the fixture.

Disadvantages of this method of fixture construction were the time required to set up and adjust the instruments; the clearance space required around each fixture to use such instruments; the need for a rigid foundation and level floor, as well as master gages; and the human element, due to which no two operators ever got the same reading from a scale held in view of the transit or level telescopes.

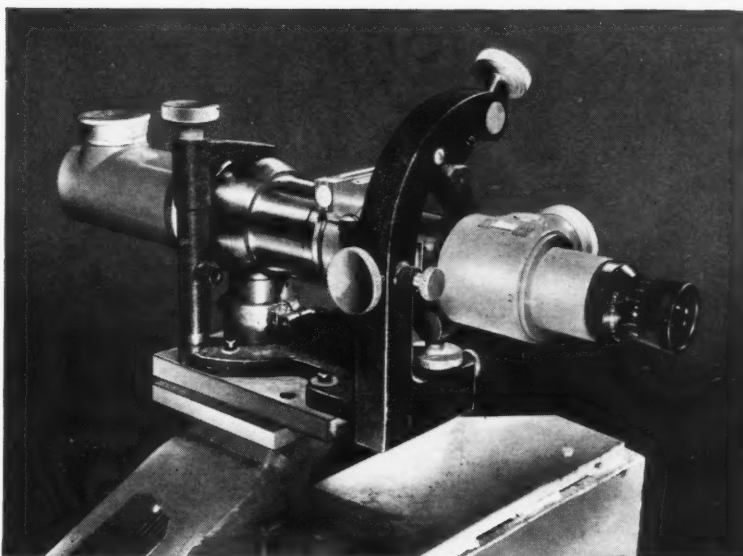
Now, however, with a reference line established directly on the fixture—independent of floor conditions—by means of optical tooling, dimensions can be held within  $\pm 0.002$  inch in 100 feet for horizontal and vertical displacement, and within 10 seconds of arc, or less than 0.0006 inch per foot, for angular displacement.

It is estimated that a saving of 30 per cent in fixture manufacturing cost is gained by the use of this method. For example, with transit and level positioning, manufacture of a B-47 aileron fixture would require 5520 man-hours of work, including making the necessary master gage for checking fixture alignment. With optical tooling, the same fixture could be manufactured, including optically located facility gages, in only 3506 hours—which is less than two-thirds of the transit and level time—and no large master gage is required. Today, all production jigs at Boeing,

*Fig. 1. Precision alignment telescope and collimator unit of the type used to establish an accurate optical reference line in making aircraft fixtures*



*Fig. 2. Spherical mount and adjustable base and bracket on which the telescope is clamped to permit alignment with the target graticule*



including those built for the use of sub-contractors, are being equipped for optical alignment.

Boeing optical tooling is based upon the use of a precision alignment telescope and a collimator unit, Fig. 1, manufactured by Taylor, Taylor & Hobson Ltd., in England, and distributed in this country by the Engis Equipment Co., Chicago. As shown, the telescope and collimator both contain a series of lenses and gratitudes, precisely located and mounted within thick-walled, hardened steel tubes. The thick walls of the tubes permit the units to be firmly clamped without distortion, and enable them to withstand mechanical shocks without upsetting the precise optical adjustments.

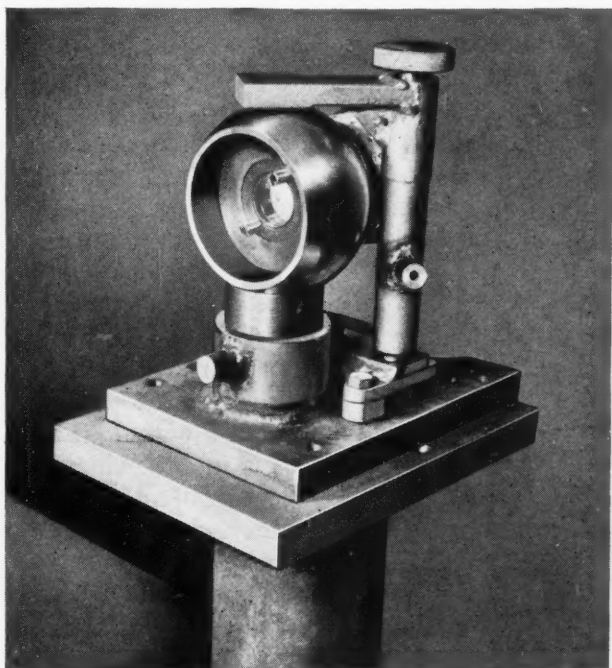
The tubes are ground and polished until their outside diameters are nearly identical, and the

same throughout the entire length, so that their mechanical and optical axes are one and the same. The diameter of the tubes is held to a total tolerance of 0.0003 inch, and parallelism is maintained within 0.0001 inch. Barrels of the instruments are chromium-plated to provide rust resistance and improved wearing qualities, and the lenses and gratitudes are coated for better light transmission.

Various modifications and improvements have been made in the Taylor, Taylor & Hobson units in accordance with suggestions of the American aircraft industry. Most important of these is a built-in optical micrometer in place of the original separate micrometer attachment, and an interchangeable high-power eye-piece.

The standard telescope has a thirty-power magnification, and this can be increased to about forty-five by means of the interchangeable eye-piece. Through a control knob and rack, the eye-piece can be focussed to any distance, from 20 inches to infinity. The telescope is normally used with a spherical mount and adjustable base and bracket, as seen in Fig. 2, which allows the telescope to be aligned with the target. A level is provided to orient the cross-hairs.

When the adjustable base has been properly located on the fixture with relation to the line of sight in both vertical and horizontal planes, it is pinned and bolted in place and becomes an integral part of the fixture. The adjustable bracket, containing clamps for holding the telescope and spherical mount in place, is bolted to the base. The spherical mount, into which the telescope is slid, is made to very close tolerances, so that the



*Fig. 3. Illuminated target graticule held in a spherical mount that can be rotated in any direction*

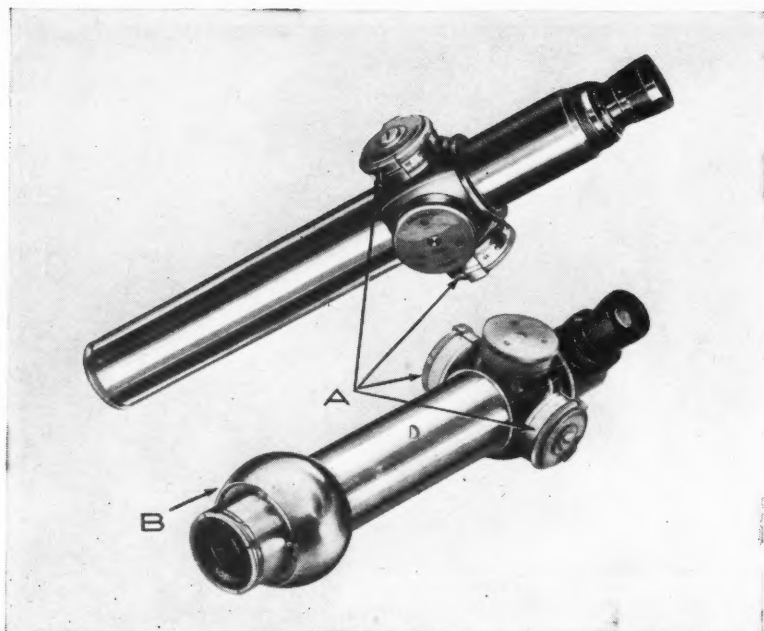


Fig. 4. Telescopes with built-in optical micrometers (A). The lower telescope is fitted with a right-angle eye-piece adapter, while the upper one has a straight adapter

optical axis or line of sight passes through the exact center of the sphere. Since the line of sight is established from a point of tangency on the sphere, which rests on a hollow vertical post projecting upward from the base, the telescope can be aligned on the target without changing the location of the established line of sight.

An illuminated target graticule held in a spherical mount is seen in Fig. 3. The spherical mount holds the target so that the star in the graticule is exactly in the center of the sphere in both planes. The mount can be rotated in any direction and will still accurately locate the reference planes.

Built into the newer telescopes as an integral part, Fig. 4, and secured to the spherical mount by means of three thumb-screws on earlier model telescopes are optical micrometers for accurately measuring displacement. The optical micrometers are seen at A, and a spherical adapter at B. The telescope shown at the top is equipped with a straight eye-piece adapter, while the lower one is fitted with a right-angle adapter. The optical micrometers contain a glass block, approximately 1 inch thick, with extremely flat and parallel sides. Tilt of this block is established and controlled by a graduated knob outside of the telescope barrel. Light rays passing through the block when it is tilted against the axis of the telescope will be offset an amount depending upon the angle of tilt. This has the effect of displacing the telescope axis parallel to itself.

Each division on the graduated knobs corresponds to an effective displacement of the telescope axis of 0.001 inch. This reading is independent of the distance between the telescope and the target plug. By operating the micrometer knobs and thereby tilting the glass block

until the graticule is centered in the cross-hair of the telescope, the amount of displacement can be determined by simply reading the graduations on the knobs.

At the request of Boeing, the micrometers are now equipped with adjustable tolerance hands so that it is no longer necessary to read micrometer graduations to determine whether a fitting is aligned to drawing tolerances. It is only necessary to look through the telescope while each micrometer knob is turned through its controlled range. If, at any position during this operation, the center of the graticule passes the cross-hairs, the fitting is located properly. The full range of optical micrometers is plus or minus 0.04 inch.

The optical micrometer, which only gives parallel shift, is not used in measuring tilt. Amount of tilt can be read directly in two perpendicular planes from the graduated tilt graticule in the collimator, against the telescope cross-hairs. The collimator must be used within the line of sight, and is clamped to a bracket that is secured to the fixture part, as seen in Fig. 5. Care must be exercised in locating the bracket on the line of sight and perpendicular to it to prevent introducing errors.

A collimator adapter sleeve, Fig. 6, is sometimes used in place of a bracket. The adapter is precision-ground, with its face perpendicular to the bore. It is only necessary to align the adapter with the line of sight and clamp or bolt it in place. The collimator is then slid into the adapter and leveled to orient the target graticules. Tilt can be read directly in minutes and fractions of minutes, and is independent of distances.

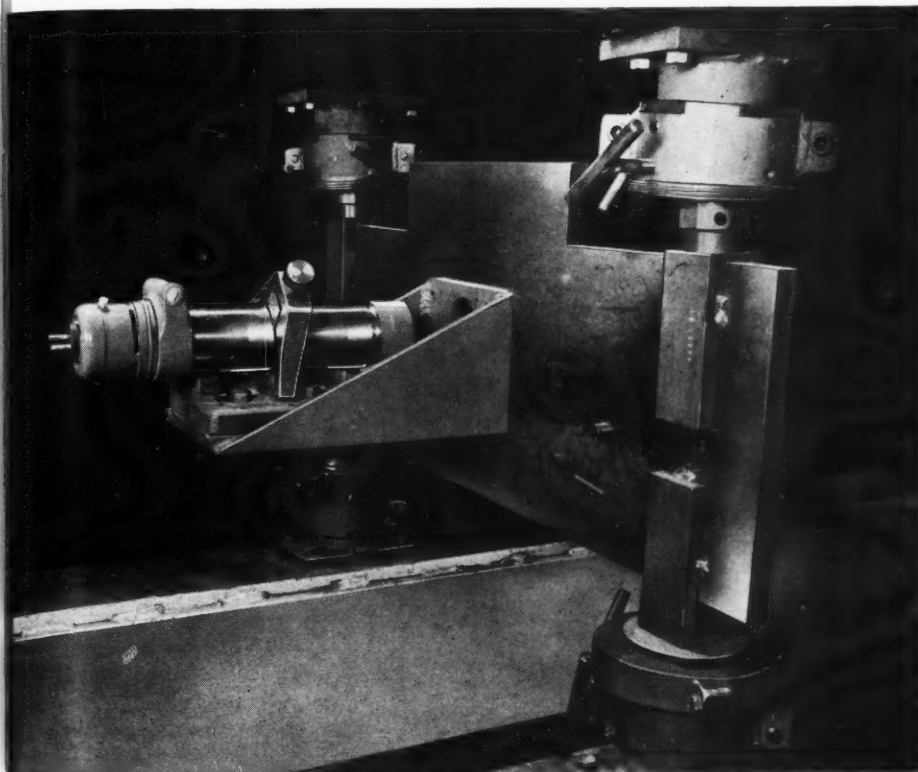
To measure displacement as well as tilt, the collimator is equipped with two graticules; the graticule nearest the telescope positions the part

with respect to displacement, while the graticule behind the collimating lens corrects the tilt. The rear graticule is viewed in the telescope in parallel light, and the telescope is focussed at infinity when viewing it. By rotating the control knob, the telescope can be focussed on either graticule. The tilt graticule is graduated in seconds and minutes of arc, so that the amount of tilt can be read in the telescope.

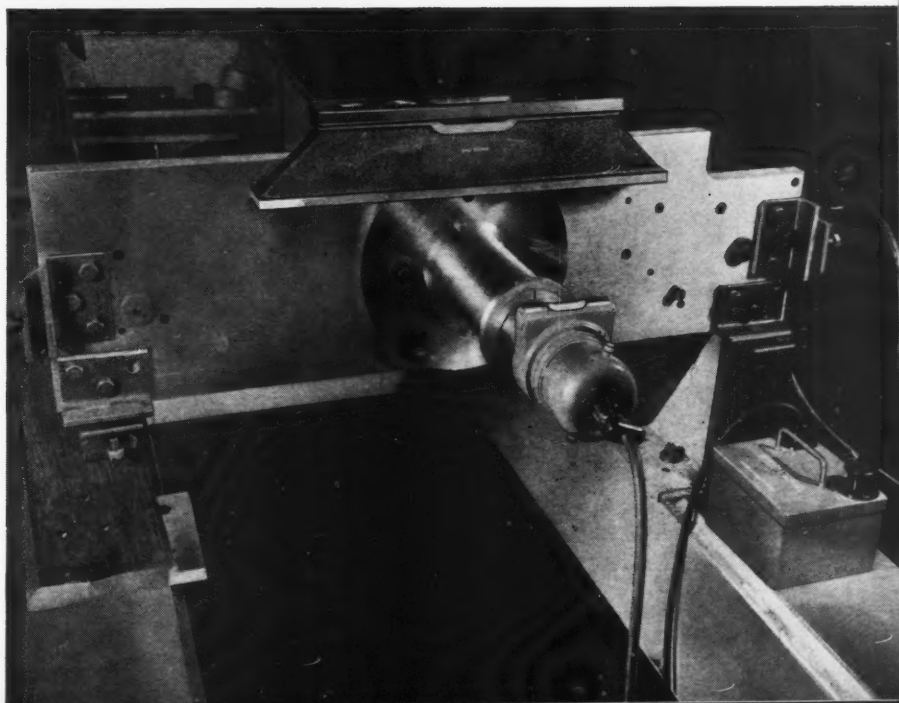
The displacement graticule in the collimator, as well as the graticules in the intermediate targets, are marked with scales, arranged around the sides of a square, in the center of which is a star formed by four V-shaped cross-hair marks

on the glass. Values of the various graduations on these scales are 0.010, 0.020, 0.050, and 0.100 inch. By adjusting the collimator or jig component so that the cross-hairs on the telescope bisect the four vees of the star, an accuracy of  $\pm 0.002$  inch can be attained without using the optical micrometer.

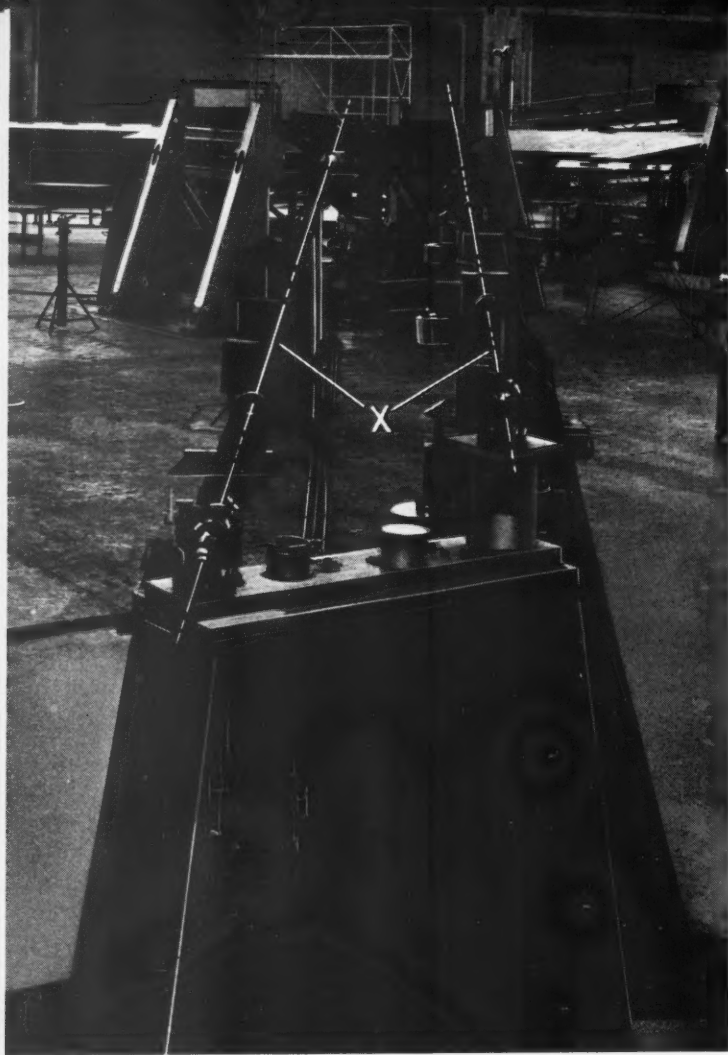
In using the optical tooling system, each end of the fixture is fitted with one or more mountings, so that telescopes and target graticules can be used to establish lines of sight through the entire length of the fixture, as seen at X in Fig. 7. From these lines of sight, any number of points between the two ends can be located simply by



*Fig. 5. Collimator clamped to bracket that is attached to a fixture bulkhead. Four adjustable clamps are used to hold and position the header of the fixture*



*Fig. 6. Another method of mounting the collimator on the fixture is by use of an accurately ground adapter sleeve*



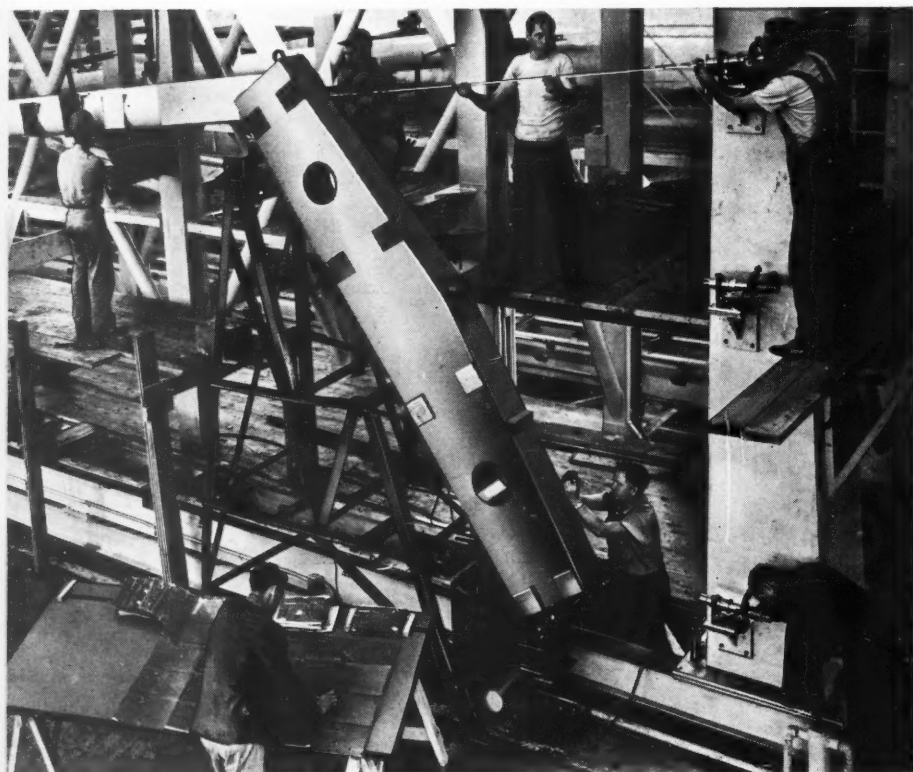
*Fig. 7. Two parallel lines of sight have been established between the telescopes (foreground) and targets (rear) on this airframe fixture*

sighting on graticules mounted in the line of sight.

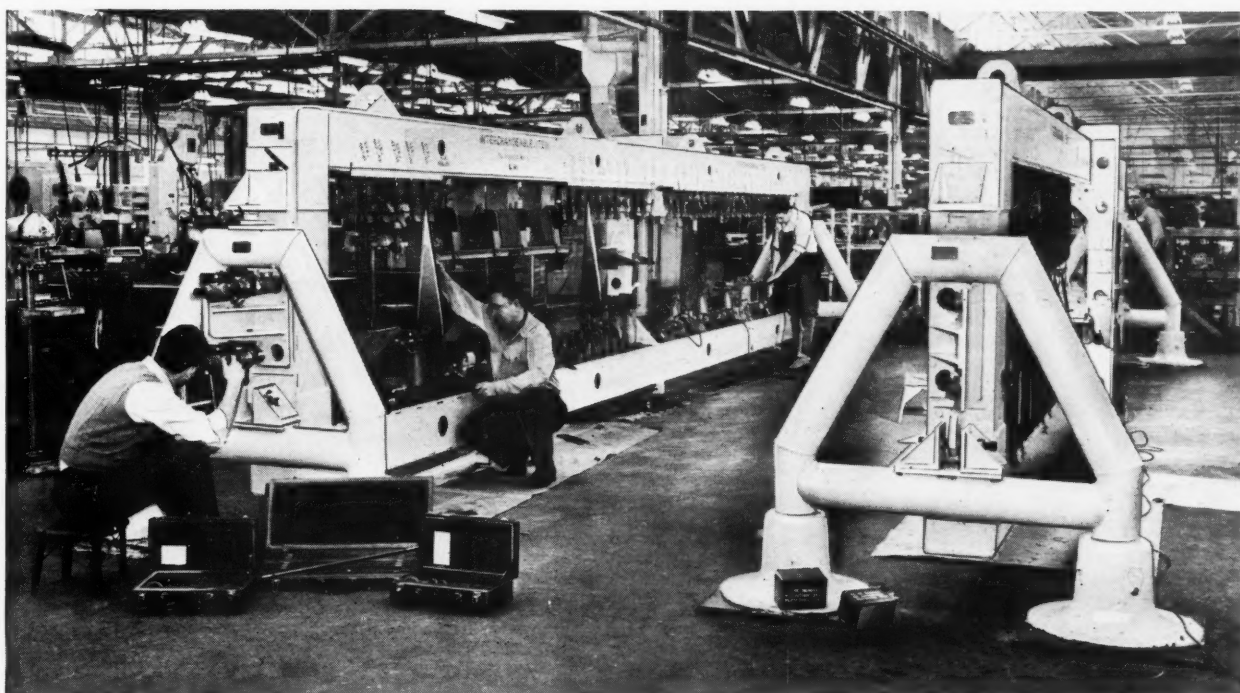
Fixture elements such as fittings containing illuminated target graticules or a collimator placed in bored holes at locations where they will be intersected by the lines of sight are prepositioned and temporarily held until the graticule can be centered in the cross-hairs of the telescope. After it has been accurately positioned, low melting-point alloy is poured around the fitting to lock it in place. When tilt must be determined, as well as lateral displacement, in locating the part, a collimator must be used in place of the simpler target graticule on the fixture part.

Fixture parts can be set at an angle, as well as perpendicular to the line of sight, by placing the collimator in the part in such a way that it is perpendicular to the line of sight while the part is at the correct angle. Then by focussing the telescope on the front or displacement graticule in the collimator, the part can be positioned accurately. The telescope is next focussed on the rear graticule so that tilt can be observed. Tilt is corrected by shifting the fixture part in the appropriate direction, after which the part is held in place by low melting-point alloy, as in the previous case.

Distance measurement along the lines of sight is accomplished by means of micrometer bars, accurate to 0.002 inch, as shown in Fig. 8. In this set-up, three inclined lines of sight and a master are being used.



*Fig. 8. Three inclined lines of sight and a master are used on this fixture. Distance along lines of sight is measured by micrometer bars accurate to 0.002 inch*



*Fig. 9. A template is accurately aligned on this aileron fixture by two parallel lines of sight. The lower telescope has an optical micrometer*

Two parallel lines of sight are being employed for the precision alignment of a template on the B-47 aileron fixture seen in the heading illustration and Fig. 9. The lower telescope in this set-up is equipped with an optical micrometer.

The advantages of this system are evident. Shop men need little or no knowledge of optics to use the optical system of fixture alignment, and yet can obtain accuracies far surpassing that of skilled transit and level operators. With the optical system, several men can take readings that will not vary more than 0.002 inch. Costs have been reduced through greatly increased speed, not only in manufacturing new

fixtures, but also in modifying and rechecking existing fixtures. For example, a typical check of a production fixture by transit and level required two transits and one level, three light extensions, six persons, and four hours' time. The same fixture can be checked with optical tooling by two operators in one-half hour, and the accuracy will be several times greater.

Expansion in the aircraft industry and subcontracting can also be facilitated, since such low-cost fixtures may be knocked down for transportation and reassembled without loss of accuracy. Interchangeability of aircraft parts made in different plants is thus improved.

# Metallurgy in Tool Design



By  
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**T**WO factors widely accepted as essential in making superior cutting tools are expert designing and precise craftsmanship. The purpose of this article is to direct attention to a third vital factor—metallurgical control. This third factor is extremely important at every stage of tool production, from the original design and material specification to the final inspection.

Many organizations require that specification of the type of high-speed steel to be used in a cutting tool must be included on the tracing when the tool is designed. But, there are so many different brand names of high-speed tool steels offered commercially that the tool designer may have difficulty selecting a type. Further, this specification should be based on actual production experience in similar set-ups, with comparable work, tooling, and operating conditions. Therefore, even when the tool material is specified, it is good practice to describe the work material and the operation in sufficient detail. The tool manufacturer may then make suggestions or recommendations of another material when previous experience indicates its superior value.

When the type of high-speed steel is not specified on the tool print, it is essential that complete details of the work material, machine tool, and operating conditions be clearly defined, so

that the manufacturer can supply tools made of the best material for the application. It is false economy to purchase tools of a standard analysis when the use of a special analysis would more than pay for the added initial cost. It is equally wasteful to use a special tool material when a cheaper, standard analysis would perform as well.

Experience under actual shop production conditions is the only sure way to determine the best tool material specification. More can be learned by actual study of tool failure under operating conditions than by any other method of predicting tool life and economy. However, it is known that the addition of certain alloying elements brings out specific physical properties. Thus, when a tool fails, the proper choice of material to resist the cause of failure and lengthen tool life is indicated.

The basic high-speed steels are generally considered to be the M-1 in the molybdenum series and the T-1 in the tungsten series. All analyses contain some vanadium, but larger percentages of vanadium are used to increase the resistance to abrasion beyond that found in the basic types. One of the inherent properties of high-speed steel is its ability to maintain a cutting edge when operated at elevated temperatures. This is known as red hardness and is increased by additions of cobalt.

# and Production

It is not the purpose of this article to go beyond the information necessary for an understanding of tool material applications, but it should be realized that the tool steel manufacturer has many problems of a metallurgical nature in controlling the balance of the alloying elements so that response to heat-treatment can be predicted. The carbon content is very important to the success of the tool, and must be carefully controlled and selected for specific tool applications. Compositions of the high-speed steels most commonly used for cutting tools are given in Table 1.

The physical properties of high-speed steel tools are probably the most important basis for selection of a starting analysis or as a guide in changing the tool material to achieve the desired results. Table 2 shows general trends in physical properties for some of the high-speed steels.

The comparative physical properties indicated in Table 2 are, of necessity, very general, but they can be useful in selecting a type of material in the light of failure in usage. For example, tool failure by chipping suggests the use of a material with higher edge toughness. If a tool fails by burning, the use of a material with

higher red hardness should be considered. When the failure is caused by wear, a steel with higher abrasion resistance might prove to be more economical. Also, relative grindability is of great importance to the tool user, since his cost of maintaining the tool is considerably increased when grindability is poor.

Different kinds and sizes of tools may vary

**Table 2. Relative Physical Properties of High-Speed Steels**

Symbol	Edge Toughness	Red Hardness	Abrasion Resistance	Grindability
M-1	Very Good	Good	Good	Very Good
M-2	Very Good	Good	Good	Good
M-3	Good	Good	Very Good	Fair
M-4	Good	Good	Excellent	Poor
M-6	Fair	Excellent	Good	Fair
M-10	Very Good	Good	Good	Good
M-30	Good	Very Good	Good	Good
T-1	Very Good	Good	Good	Very Good
T-2	Good	Good	Very Good	Good
T-3	Fair	Good	Excellent	Fair
T-4	Good	Very Good	Good	Good
T-5	Fair	Excellent	Very Good	Good
T-15	Poor	Excellent	Excellent	Poor

Order of Rating: Excellent, Very Good, Good, Fair, Poor.

**Table 1. Composition of High-Speed Steels Commonly Used for Cutting Tools**

Molybdenum High-Speed Steels						
Symbol	Approximate Analysis, Per Cent					
	Molybdenum	Chromium	Vanadium	Tungsten	Cobalt	Carbon
M-1	8 1/2	4	1	1 1/2	...	0.80
M-2	5	4	2	6	...	0.83
M-3	6	4	3	6	...	1.15
M-4	4 1/2	4 1/2	4	5 1/2	...	1.27
M-6	5	4 1/2	1 1/2	4	12	0.78
M-10	8	4	2	...	...	0.85
M-30	8	4	1	2	5	0.80

Tungsten High-Speed Steels						
Symbol	Approximate Analysis, Per Cent					Carbon
	Tungsten	Chromium	Vanadium	Cobalt	Carbon	
T-1	18	4	1	...	0.72	
T-2	18	4	2	...	0.82	
T-3	18	4	3 1/4	...	1.05	
T-4	18	4	1	4	0.75	
T-5	18	4	2	8	0.80	
T-15	13	4 1/2	5	5	1.50	

widely in the percentages of material and labor costs that together make up the total tool cost. If high labor costs make a tool relatively expensive, it is good business to use a tool material that will give maximum performance, since the higher base price of the material does not seriously affect the total cost when viewed on a percentage basis. The specification of a tool material that is difficult to work must presume a long tool life in order to compensate for the higher initial cost and the increased maintenance cost.

While grindability affects the maintenance costs, as well as the purchase price, there are some other peculiarities of the higher alloy analyses that limit their broader application. This is particularly true when the use of accurate underground tools is indicated. Certain analyses do not remain stable during heat-treatment, and it is not possible to predict dimensional changes in spite of any precautions and care taken in the heat-treatment. Some materials are difficult to forge and others require unusual heat-treating procedures. So many technical factors enter into tool material specifications from the stand-

point of the tool manufacturer's cost that it is wise to consult with the manufacturer before specifying the use of an unusual analysis.

Some of the less common materials are difficult or impossible to procure in certain sizes or conditions. Therefore, availability must be given consideration before specifying any unusual tool material. Extended deliveries often prevent the use of a material whose properties appear interesting because production requirements must be met, and for this reason tools made of a readily available material have to be employed.

### *Metallurgical Control in Production*

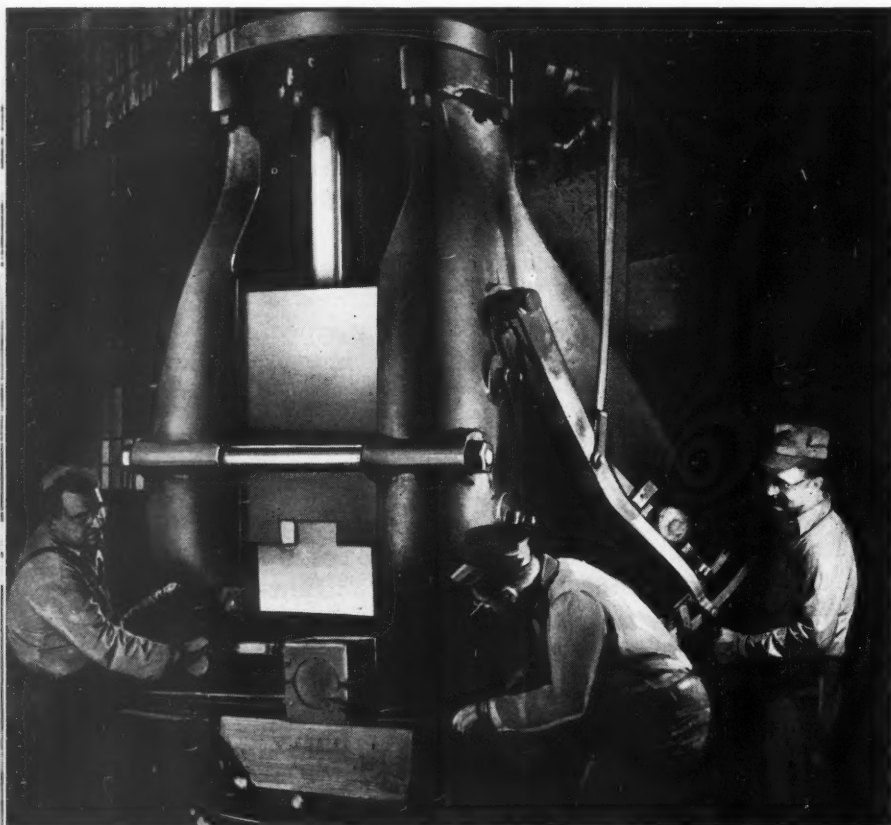
The production of superior cutting tools requires complete metallurgical control of every phase of the operation from receiving inspection of the tool material through the final inspection of the completed tools. Metallurgical control begins with the specification of the analysis and physical properties to which all purchased material must conform. This assures that any batch will respond to forging and heat-treatment just as any other batch has done in the past, or will do in the future.

It is not sufficient control to merely set up these specifications; facilities and personnel must be available to check adherence to the required standards. All raw material should be checked for analysis, grain size, carbide size,

segregates, slits or other flaws, decarburization, and hardness.

The question of whether to use bar stock as it comes from the tool steel mills or to use individual forgings for cutting tools has been debated ever since high-speed steel has been available. No high-speed steel blank is in its best condition unless it has received sufficient working, Fig. 1, to break up and evenly distribute the carbides into a homogeneous state. It is possible to work bars of small cross-section until a satisfactory structure is obtained. However, it is practically impossible to work bars of large cross-section so that blanks cut directly from such bars can be made into tools with maximum strength and productive capacity. In general, the use of individual forgings is necessary to get best results from medium- or large-sized tools.

Good forging procedure starts with the selection of the proper size of billets, so that the reduction ratio will require adequate working of the blank. For maximum strength in the finished tool, the material must be displaced under the hammer in such a way that the flow lines in the resultant blank are transverse to the plane or planes of greatest stress. The carbide network in the billet must be broken up and the carbides uniformly distributed so that the structure of the blank will be homogeneous. The structural control of formed forgings, such as shaper cut-



*Fig. 1. Forging of high-speed steel tool blanks insures the breaking up and even distribution of the carbides into a homogeneous state*

*Fig. 2. High-speed steel broaches are shown being lifted from a vertical, controlled-atmosphere furnace after careful heat-treating*

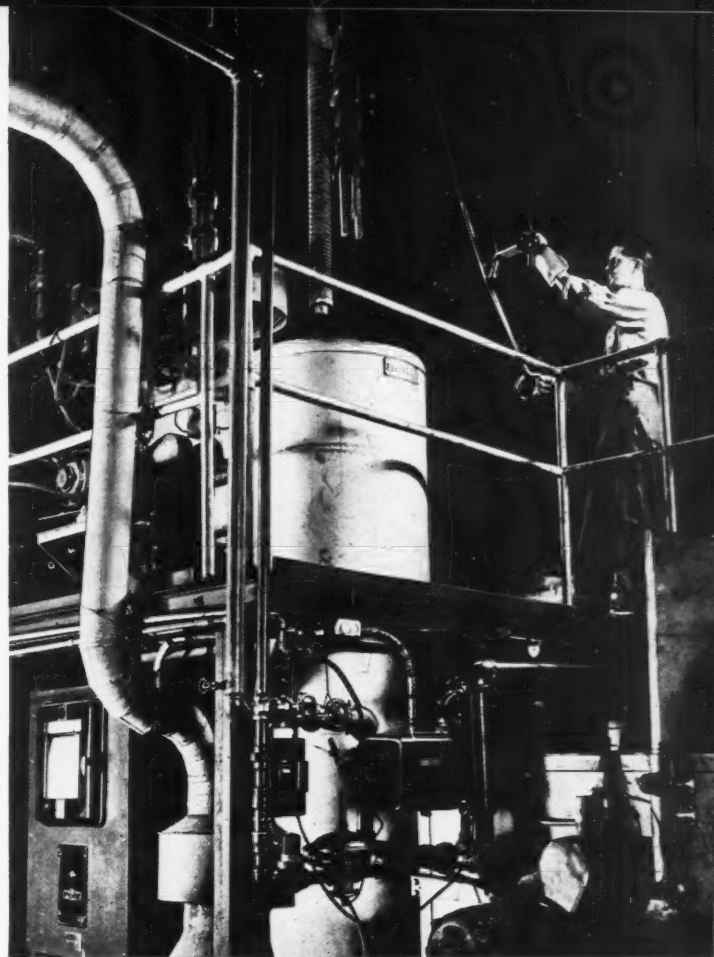
ter blanks, is particularly important so that the completed tools will have maximum strength and cutting ability. Forged blanks are annealed following the forging process to relieve inherent stresses and bring the hardness to the desired range for machinability.

The manufacture of a cutting tool that will operate at the lowest over-all cost depends more on the heat-treatment given the tool than on any other single factor. The heat-treatment of high-speed steel cutting tools is not a process that can be specified or controlled easily. Every variation in analysis, even though within the permissible commercial range, influences the temperature, time, and conditions of heat-treatment. Shape and size of the tools must also be considered. The application of each different tool must be well understood, and a heat-treatment used which brings out the characteristics that will make that tool superior on the job to which it is assigned. Experience alone can give the answers to these problems.

The heat-treating equipment must not only be adequate to produce the desired results, but must be carefully maintained if the quality of the work is to be held to a high standard. Unground cutting edges must be free of decarburization if they are to do a good job. Dimensional changes must be predictable within very close limits if unground tools are to be satisfactory.

Much has been said about the relative value of salt bath equipment versus other types of furnaces for heat-treating high-speed steel. The fact remains that certain combinations of analysis, shape, and size are best treated in salt baths, while others turn out best when heat-treated in muffle type, controlled-atmosphere furnaces, such as the one seen in Fig. 2. It is necessary for a cutting tool manufacturer to have both kinds of furnaces available if a wide range of efficient tools is to be produced.

Quality control of high-speed steel hardening requires not only good furnace equipment, but adequate accessories for holding the desired temperatures, atmospheres, salt conditions, etc. The over-all cost of maintaining such equipment is so great that it can only be justified when large-scale production is demanded. This is the greatest single reason why large producers of cutting tools can afford to give the best metallurgical treatment to even small jobs. In such a plant, a sufficient volume of tools to be heat-treated is generally available, so that each job can be



scheduled for the equipment and processes that will result in optimum tool performance.

Before a tool is released for the finishing operations, it must be checked to insure that it has responded to heat-treatment as specified. Most hardness tests are run on a Rockwell tester after grinding a spot or surface on which an accurate reading can be taken. When checking the hardness of an irregular-shaped tool that cannot be staged in a Rockwell machine, a file in the hands of an experienced inspector is a reliable testing device. Decarburization can also be noted with a test file if the user has sufficient background to interpret the results. The most difficult flaws to detect are small cracks, which may have resulted from thermal stresses at sharp corners or at large variations of mass in the tool. These are best found by a magnetic inspection.

It is essential that the facilities of a metallurgical laboratory be available as the final check on the heat-treating department. There are many factors that influence the performance of cutting tools that can only be determined when a complete metallurgical inspection is available. Among these factors are the presence and extent of decarburization, the determination of grain size, the investigation of the structure for segregation and banding, and a check to be certain that the heat-treating process is resulting in the desired structure before further work is done on the tool. Good practice requires that test blanks

be processed periodically with the work to insure that all operations are contributing their share of quality to the tool.

Cleaning by washing or blasting is often necessary between heat-treating operations to prevent residue from a previous treatment from pitting the work or interfering with subsequent operations. This is particularly true of salt bath treatments. Rusting and pitting of tools even after delivery to the customer may be the result of inadequate removal of residual salt after a salt bath treatment. If cleaning is slighted, serious consequences may appear at a later time, when it is difficult to place the responsibility. This danger requires that washing and blasting operations be carefully supervised so that the tools will be free of residue.

### *Value of Supplementary Treatments*

The value of supplementary treatments is a controversial subject. Case histories prove the value of some such treatments over extended periods, but only where there was a need for the additional qualities imparted by the treatment in the specific tool application. There are also many case histories that prove such treatments actually decreased tool life and resulted in higher unit tool cost. This contrasting evidence indicates that supplementary treatments can be of real value only when properly applied to jobs that require the possible benefits.

Some treatments that involve heating the tools to the usual tempering temperature are claimed to be of value because they add another tempering cycle to the normal heat-treatment. Good high-speed steel hardening requires at least two tempering cycles, or draws, and it is difficult to prove the value of additional tempering if the original treatments were carried on for the correct lengths of time and at the required temperatures. This must not be confused with stress relieving, which is a common practice on tools made of certain steel analyses after grinding operations and after resharpenering. Stress relieving is carried on at a much lower temperature than tempering, and is not intended to promote structural changes but merely to relieve internal stresses set up by grinding.

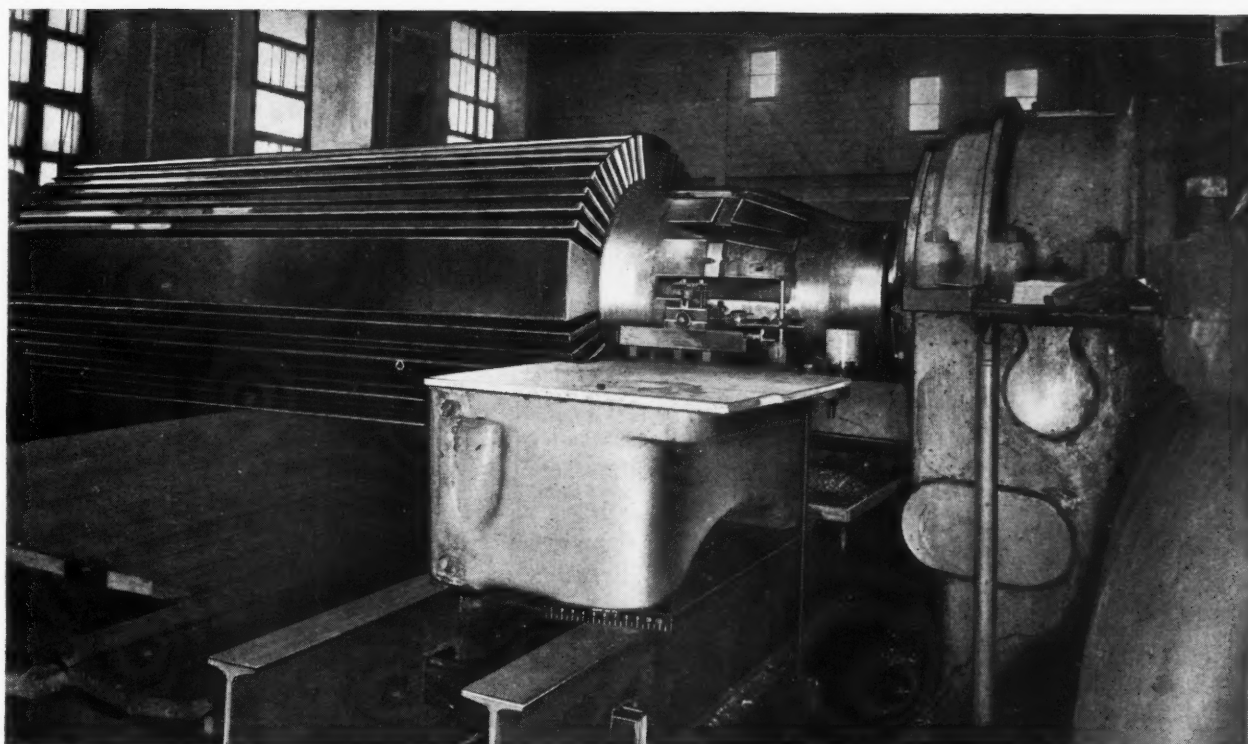
Typical supplementary treatments performed on cutting tools include "Vapo-blast," casing salt, and oxide treatments. "Vapo-blast" is a mud-blasting treatment which produces a smooth gray finish that is often helpful for its lubricant retention abilities and reduction of friction. It in no way changes the metallurgy of the tool, but is credited with improving surface finish to a limited extent. When applied after grinding

operations, the "Vapo-blast" treatment removes grinding burrs. Because of its attractive appearance, it is sometimes used following casing salt treatments to remove the less attractive mottled salt finish. Its widest field of application is on broaches, reamers, core-drills, and fine-pitch form-relieved cutters and hobs. This treatment may be repeated any number of times without detrimental effect.

The casing salt treatment consists of a salt bath that is maintained at about normal tempering temperature, and the tools to be treated are submerged either before or after grinding. This treatment produces a measurable case on all outside surfaces in contact with the salt. The depth of the case, which is usually less than 0.001 inch, depends on the length of time of immersion at full temperature and the strength of the salts. The case thus produced has a higher carbon content than the body of the tool, and is appreciably harder than the fully heat-treated high-speed steel. It is also important to understand that this case is less tough than the body of the tool.

Casing salt produces a surface with higher abrasion resistance than the normal hardened high-speed steel, and the residual surface has better lubricating retaining properties than ordinary ground finishes. It is evident that casing salts are best applied on tools subject to wear by rubbing action, such as reamers, core-drills, hobs taking light cuts, etc. Since the case is comparatively thin, it is often removed by sharpening. Some tool men suggest recasing after each resharpenering, but this can lead to too deep a case on surfaces that are not ground during resharpenering. This condition may cause failure due to chipping and breakage of the cutting edges. A tool treated with casing salt never has the edge strength of an untreated tool. This leads to the conclusion that such a treatment should not be specified on tools subjected to chatter and vibration, because it may result in failure of the weaker edges.

Oxides are purposely formed on some high-speed steel tools by various methods, in which the tool is subjected to heat in the presence of an oxidizing agent. One method is the steam treatment. The resultant black oxide so formed has an attractive appearance and definitely has lubricant retaining properties. This treatment does not affect the metallurgical properties of the steel, and there is no penetration as in the casing salt treatment. It may be repeated any number of times without detrimental effect. The slipperiness of the oxide surface also assists chip flow and helps prevent galling and welding. In addition, it is helpful on rubbing and piloting surfaces for the same reason.



# Taking Machines to the Work

In Machining Large Castings or Parts of Heavy Machinery, it is Often Difficult and Costly to Move the Work to the Machine Tools. This Article Describes a Means of Turning, Boring, Milling, and Grinding Such Work without Moving it

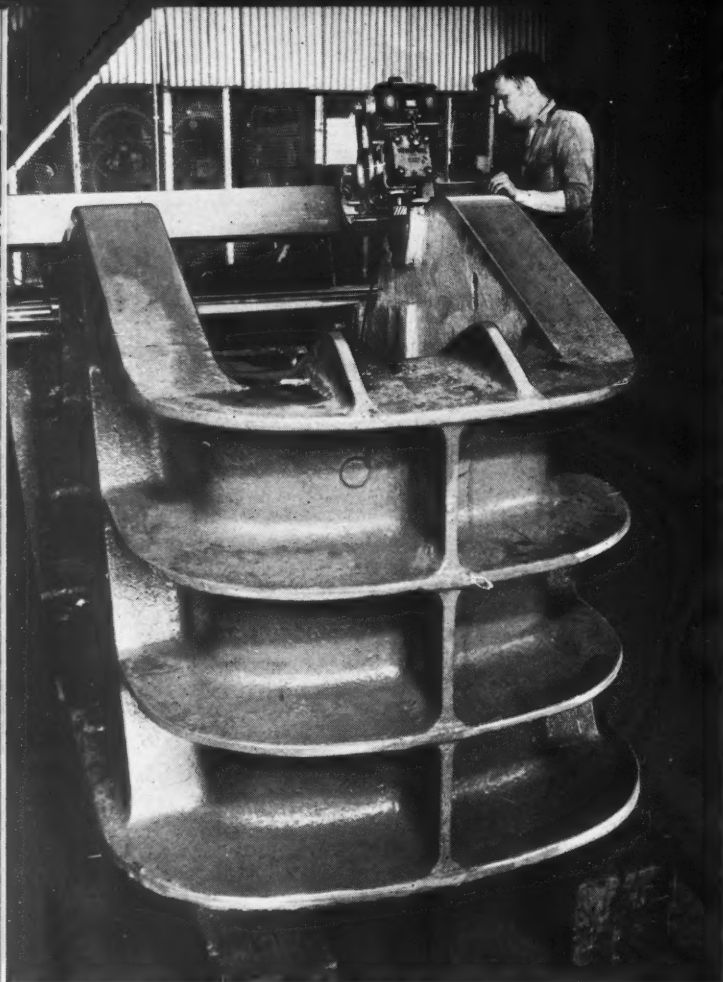
By GEORGE H. DeGROAT

**W**HEN it is necessary to machine heavy frame castings or parts of large machines, such as turbines or huge generators, it is often found that machine tools of sufficient capacity to accommodate the work are not readily available. Even when the work to be machined can be moved without tearing out a wall of the building, the major portion of the cost of the job is usually due to the time spent in disassembling, moving, and setting up the cumbersome work. Sometimes weeks are lost because of previous commitments on the large machine tools in the manufacturer's plant when such heavy parts are returned for repair or reconditioning. This problem has been considerably simplified by the availability of a device, known as the "Versa-Mil," that can be taken to the work for precision milling, boring, grinding, and other operations.

This portable machine tool, which was developed by the Versa-Mil Co., New York City, is

capable of milling a 1-inch keyway, full depth, in mild steel at better than 1 inch per minute. It has twenty-six milling and boring speeds and twenty-eight grinding speeds, with a total range of 44 to 18,000 R.P.M. This device is easily mounted on a carriage, table, ram, turret, or tool arm of machine tools. It can also be used as a machine tool itself when mounted on a bench or on a casting or other large part that is to be machined. When employed in this way, the Versa-Mil is combined with a feed table, thus providing three dimensional feeds for moving the tool.

An example of the latter application may be seen in Fig. 1, where the device is shown being employed to machine a 10-ton cast-alloy steel frame of a Stirling 36- by 24-inch stone and ore crusher. The work was done in the Rodermond Industries shops in Jersey City, N. J. It consists of machining male and female mounting surfaces for the jaw shaft bearing caps. Since the casting



*Fig. 1. The mounting surfaces for bearing caps on the 10-ton cast-alloy steel frame of an ore crusher were machined without moving the casting from the shop floor*

bearing seats for an eccentric shaft were being bored, as may be seen at the left. Moving, set-up, and other costs were considerably lower, compared with what the expense would be if large machine tools were used.

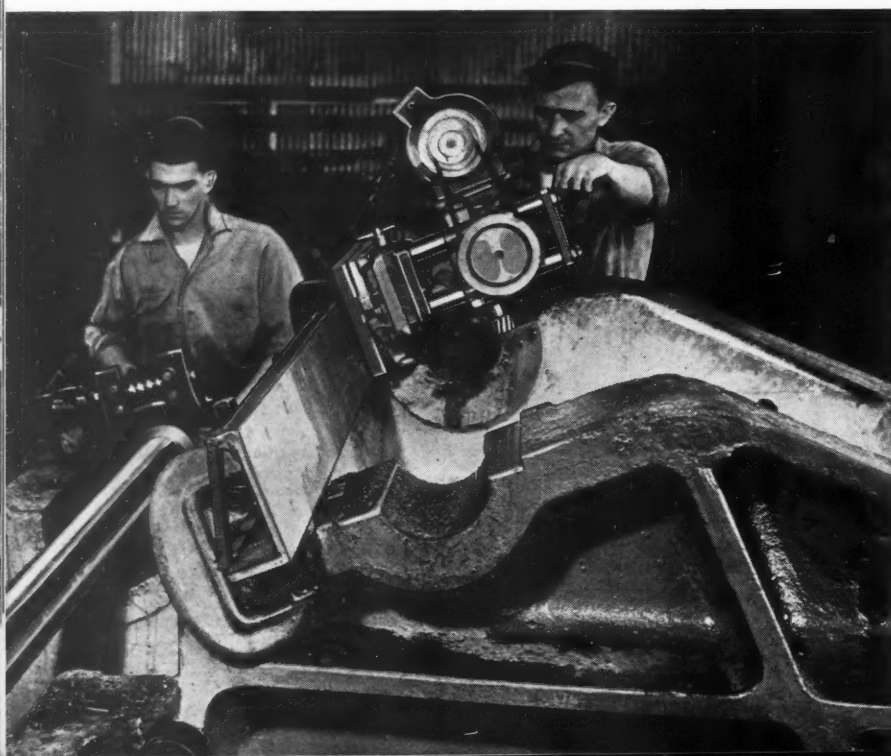
Another interesting application of this device is illustrated in Fig. 4. This is a cylindrical grinding operation on the surface of a badly scored roll, one of two used in a drum dryer at the Colgate-Palmolive-Peet plant in Jersey City, N. J. These rolls are hollow cast-iron cylinders 42 inches in diameter and 10 feet long. They had become so badly pitted that a uniform product could no longer be obtained, and because of added resistance between the rolls and the doctor blades that remove dry material, the power requirements of this machine rapidly increased.

The reconditioning of such rolls formerly required disassembling the machine, loading the rolls on flat cars, and shipping them to the manufacturer's plant, where they were turned to restore true surfaces and then ground to provide a good surface finish. To ship these rolls would necessitate breaking a wall of the plant, since they were too large to pass through available passageways. The estimated cost for reconditioning the two rolls in this way was \$12,000.

A Versa-Mil with an external grinding spindle and a feed table provided a means of doing the job without disassembling the rolls. A bridge, with ways and a lead-screw feed to provide a power-operated carriage feed for the length of the roll, was constructed and attached to the

was too large to pass between the columns of the largest planer available, a Versa-Mil with a feed table was mounted on a fixture clamped to the casting. In this way the frame was face-milled without moving it from the machine shop floor.

A 1 1/2-inch diameter end-mill operating at a spindle speed of 112 R.P.M. was employed for this job. Fig. 2 shows one of the surfaces finish-milled and the second one in the process of being milled. While this work was being performed,



*Fig. 2. Milling the cast frame shown in Fig. 1 with a Versa-Mil eliminated considerable difficulty and delay, since the frame could not pass between the columns of the largest planer available*

*Fig. 3. Versa-Mil units mounted on feed tables were employed to machine slots 1 1/4 inches wide by 4 inches long in grooves previously turned in the rotor*

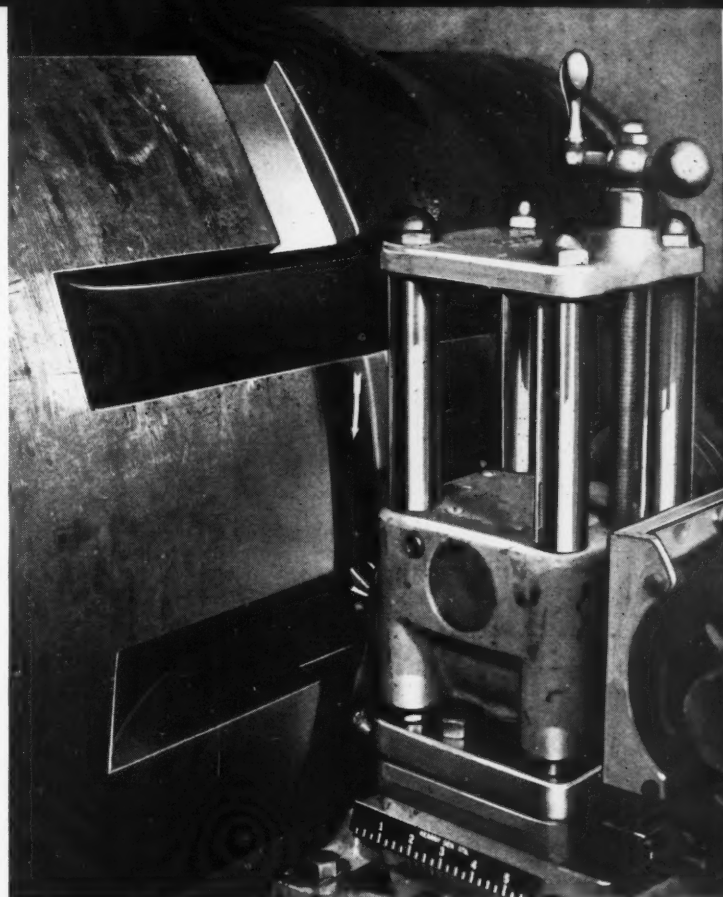
frame of the drum dryer. The Versa-Mil unit and feed table were mounted on this bridge. Grinding the rolls removed sufficient metal to recondition them, and each grinding pass for the length of the roll required only twenty-five minutes. At points of maximum out of roundness, 1/16 inch of metal was removed.

The total time this drum dryer was out of operation during the reconditioning process was under ten days, as compared with six to seven weeks of lost production time estimated on the basis of doing the job in the former manner. The cost of equipment and labor, including experimental time while the Versa-Mil method was developed, was less than 20 per cent of the estimated cost of the conventional method.

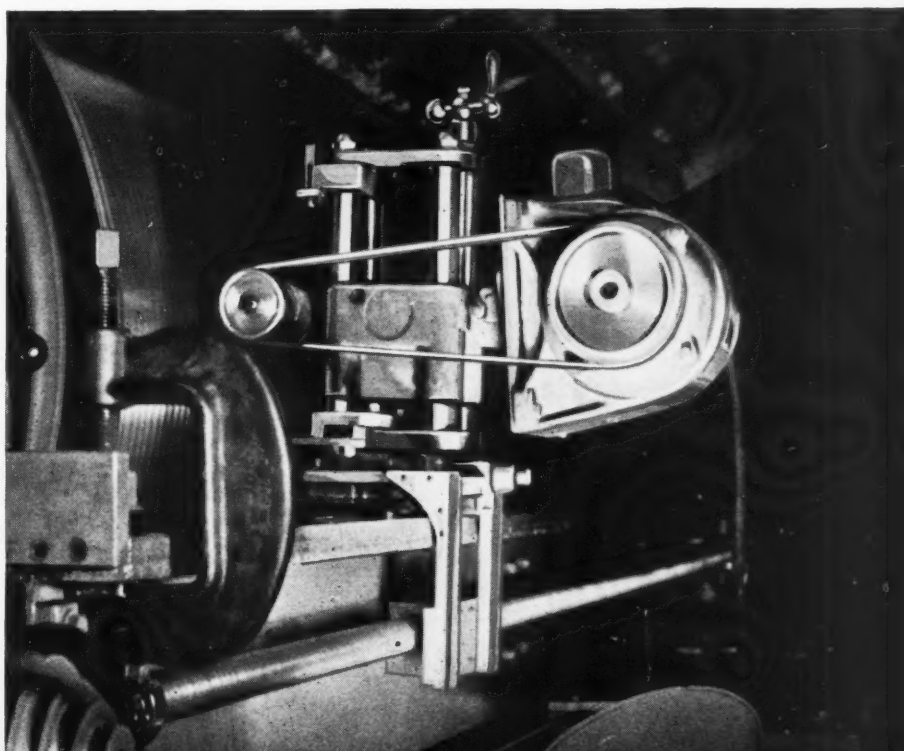
In another case, the installation of a new design of clamping ring for the coil support at each end of a generator field rotor required extensive machining of the rotor ends. This work was accomplished at the generating station of the Public Service Electric & Gas Co., Kearny, N. J., without returning the rotor to the manufacturer's plant, thus saving considerable "down time" and expense. As may be seen in the heading illustration, which shows one end of the generator rotor, an exciter base and 15-inch I-beams were used to support a Versa-Mil feed table. A similar set-up was employed at each end of the rotor. Two cuts were made simultaneously by using a lathe tool in each table to turn a 3-inch wide by 1-inch deep circumferential groove in the rotor ends. The work was rotated

by means of gearing-rigged to drive it in its own bearings.

A close-up view of the finished groove may be seen in Fig. 3, which shows another operation on this rotor. Here, a Versa-Mil is set up on a feed table for milling slots 1 1/4 inches wide by 4 inches long in the bottom of the groove. Altogether, the time required to machine the rotor in the manner described was approximately seventy-two hours. This amounts to an extraordinary saving compared with the time that would be needed to disassemble and ship the generator rotor out of the plant for machining.



*Fig. 4. A Versa-Mil with an external grinding attachment and a feed table was employed to resurface the 42-inch diameter, 10-foot long hollow cast-iron rolls of a drum dryer*



## Five Hundred Dollars in Prizes for Articles on Ingenious Mechanisms

MACHINERY offers \$500 in cash prizes for the eight best articles on ingenious mechanisms to be submitted to the Editor before November 1 of this year. Each article should be confined to a description of one mechanism or one mechanical movement that has proved its practicability in actual use and has not previously been described in the technical press. The money will be distributed as follows:

First prize .....	\$200
Second prize .....	\$100
Two additional prizes.....	\$50 each
Four additional prizes.....	\$25 each

In addition to these cash prizes, MACHINERY's high-level space rates will be paid both for prize-winning articles and for all other articles accepted for publication that may not receive a prize.

Each contestant may send as many articles as he wishes. All will be entered in the competition and all may be accepted for publication; but no contestant will be awarded more than one prize.

Articles entered in this competition should be addressed to the Editor of MACHINERY, 148 Lafayette St., New York 13, N. Y., and must be mailed on or before November 1.

This competition applies to any kind of mechanism making use of a practical and ingenious mechanical motion or principle. The competition is open to all, whether subscribers to MACHINERY or not. The procedure is simple.

1. Send a drawing of the mechanism (or photograph if preferred—or both) that clearly shows all important parts of the particular movement to be described.

2. Describe as clearly as possible both the *purpose* of the mechanism and its *action*—how it does *what* it does.

3. Mark the important parts on the drawing, such as levers, cams, etc., with letters, A, B, etc., and use corresponding letters to identify those parts in the description; thus, "Lever A is operated by cam B." This will help to make the description readily understood.

4. Confine each article to a single mechanism or movement; do not describe an entire machine or refer to parts that do not affect the movement being described.

Clear blueprints or pencil drawings with distinct lines are satisfactory for illustration. They should be made on separate sheets of paper. Send only drawings that are to scale, with the various parts shown in correct relationship and proportion. Rough free-hand sketches cannot be used. The drawing must show the assembled mechanism, although a diagram or a drawing that is partly diagrammatic may be substituted to advantage, especially if it more clearly illustrates the arrangement of a mechanism that is particularly complicated.

It is more essential that important facts be clearly stated than that the manuscript be neatly written; but carefully prepared manuscripts usually indicate careful thought.

Avoid describing a mechanism that is familiar to most designers; descriptions of movements that are generally known cannot be accepted, even though they may be very ingenious. It is immaterial how long ago a mechanism or movement was designed, provided it has not previously been described.

### Important Suggestions

*Be sure to describe as clearly as possible both the purpose of the mechanism and its action — what it does and how it does it. Describe the purpose first, and the means of accomplishing it afterward.*

*Confine each article to a description of a single mechanism or mechanical movement. Do not describe the entire machine of which the mechanism or movement is a part. Clear*

*descriptions of separate mechanisms rather than descriptions of entire machines are desired. Omit reference to parts of machine that do not affect the movement being described.*

*Do not describe mechanisms familiar to most designers. On the other hand it is immaterial how long ago a mechanism or movement was designed; but it must not have previously been described in any publication or textbook.*

# Stretch-Forming on a Press Brake

By GILBERT C. CLOSE

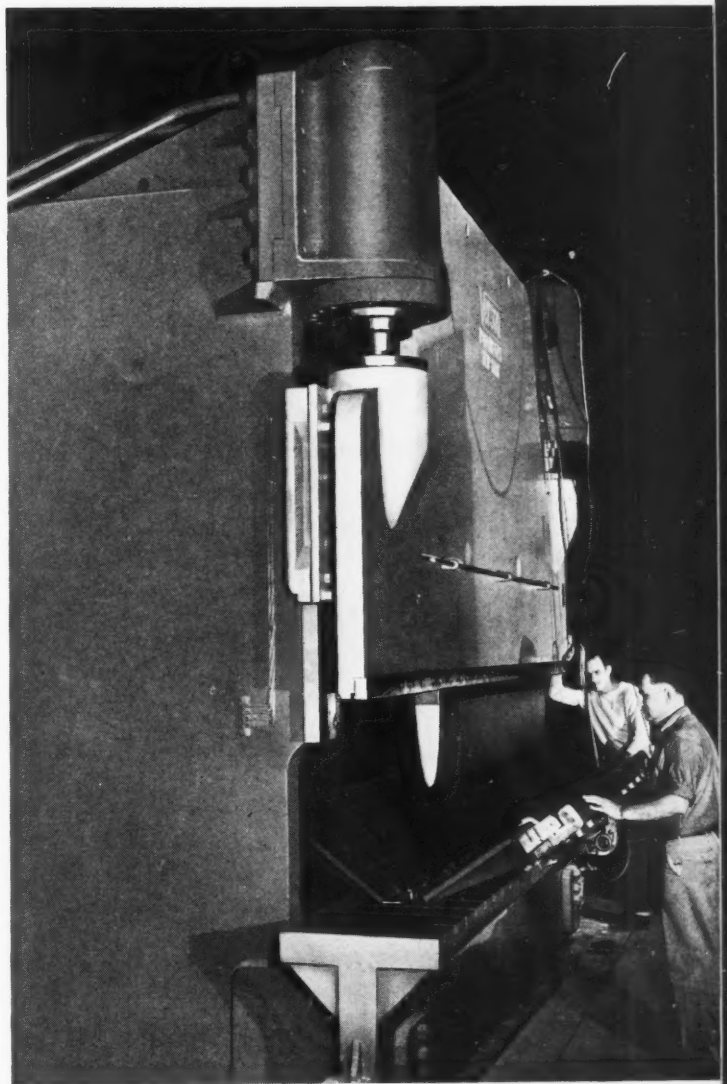
**A** MODIFIED 400-ton hydraulic press brake is being used in the shops at Northrop Aircraft, Inc., Hawthorne, Calif., for precision stretch-forming of aluminum skin sections for high-performance military airplanes. With this equipment, it is possible to finish-form a wing leading edge in from two to three minutes. The same job performed on an ordinary press brake, using repeated strokes and auxiliary heating to build up the desired contours, requires from eight to ten hours. Furthermore, work produced on the modified press brake meets precision standards that cannot be equalled using the older method.

The modifications required on the hydraulic press brake are basically simple. A Kirksite die conforming to the shape of the finished part is used. This die is machined to the required contour and is then mounted on the ram of the press brake, as shown in the accompanying illustrations.

A series of air-actuated clamps, made in 16-inch sections and hinged to the bedplate of the press brake, is used for holding the sheet during stretching. These clamps weigh about 90 pounds each, and as many as are required can be mounted on the bedplate.

Two types of clamps are used. One grasps the metal vertically, parallel to the direction of stretch, as seen in Fig. 1, and the other grasps the metal at right angles to the direction of stretch, as seen in Fig. 2. With the 90-degree clamps, a radius-bar is used for easing the sheet into the plane of stretch. As friction between the sheet and the radius-bar lightens the load on these clamps, they are preferred despite the fact that the salvage strip is 6 inches wide, as compared to 1 1/2 inches for the vertical clamps. In the set-ups illustrated, an overhead hoist was used for folding the clamps together, but hydraulically actuated clamps have now been designed.

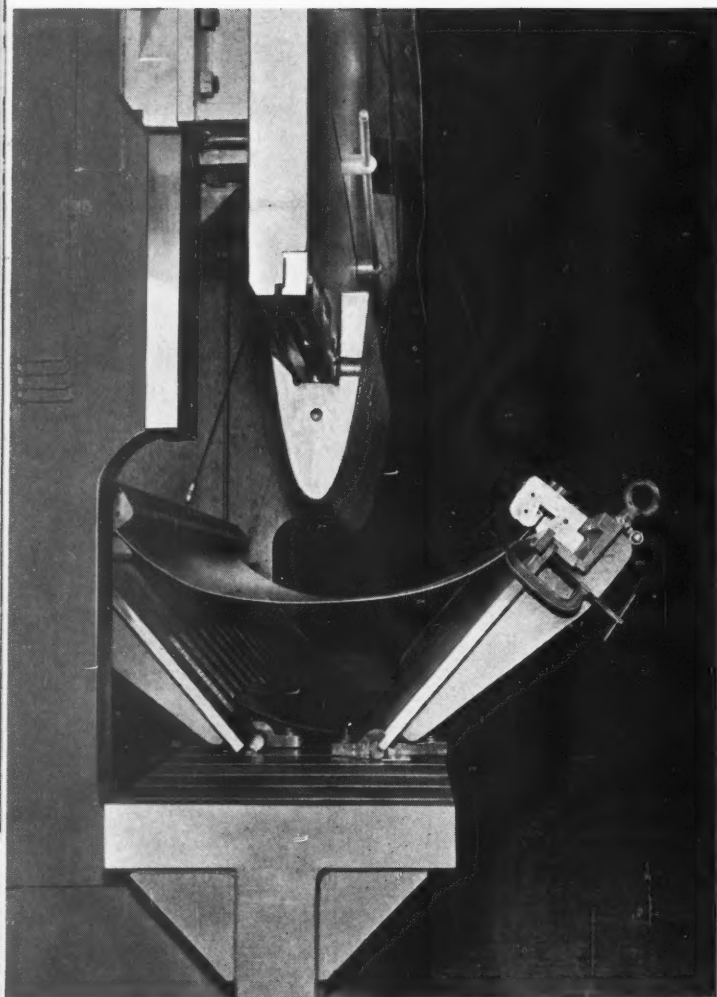
The controls and gages are mounted on the right-hand end of the modified press brake, as seen in Fig. 3. The two dial indicating gages show the hydraulic pressure exerted on the ram of the press brake. The vertical, graduated slide



gage, seen at the left of the pressure gages, is used to set the distance that the punch travels. A micrometer adjustment is provided on this gage for fine settings. The gear, chain, and handwheel arrangement seen at the left of this gage permits adjusting the amount that the press-brake ram and punch are tilted.

An electrical switch attached to the overhead hoist used in raising or lowering the stretch jaws, is shown in the operator's left hand. His right hand is on one of two valves employed to open and close the clamping jaws. The foot-actuated switch controls the movement of the press-brake ram and punch. Limit switches, accurate to within 0.002 inch, are used for controlling the amount of stretch. This press brake has a 24-inch stroke and 34-inch die opening and can handle sheets up to 160 inches in length. When required, overloading of the brake up to 600 tons is permissible.

In experimental work preceding production stretching, it was determined that aluminum sheet stock can be stretch-formed around dies



**Fig. 1. Modified press brake for stretch-forming aluminum-alloy sheets into leading edges for airplane wings. Employing the type of clamp here illustrated, the sheet is grasped vertically, parallel to the direction of stretching**

with apex radii down to 1/8 inch. Optimum elongation during stretching is from 5 to 6 per cent, although as much as 20 per cent elongation was accomplished without tearing the sheet. Using the optimum elongation, no cracked parts or springback results. After stretching, the sheet lies snugly against the die, and when removed from the brake, Fig. 4, fits just as snugly around the template. Ordinary crankcase oil is used as a forming lubricant.

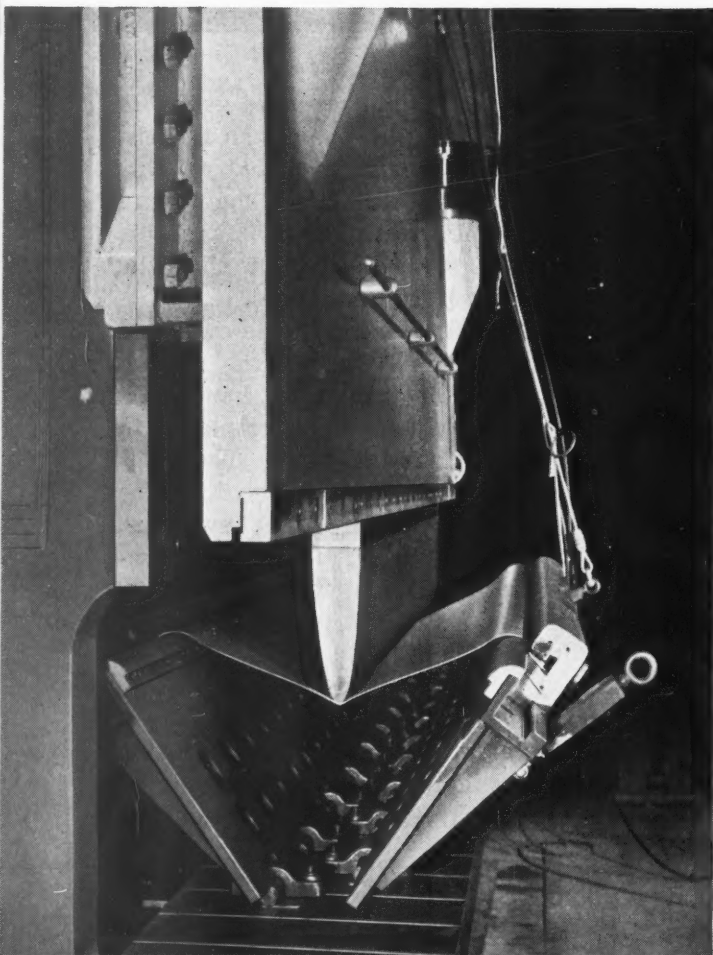
All production work to date has consisted of stretch-forming 75S aluminum alloy immediately after heat-treatment, and while it is still in the "W" condition. Subsequent age-hardening of the formed parts brings the alloy to the "ST" condition. Although sheets up to 0.250-inch thick have been formed, the maximum thickness of current production work is 0.156 inch.

The sheet stock now being stretch-formed is tapered in thickness. This tapering is accomplished on a metal planer with a high-cycle cutting head. One size of sheet tapers from 0.156 to 0.129 inch in thickness, another from 0.129 to 0.107 inch, and a third from 0.107 to 0.085 inch. The rigid mounting of the stretch-die and holding clamps prevents adverse effects from the varying pressures encountered in forming these tapered sheets.

Microscopic examination of the stretched sheet stock in the areas of greatest elongation indicates very little effect on the metal grain structure when elongation is held between 5 and 6 per cent. Tensile specimens cut from various sections of a stretched sheet showed no serious variation in strength. Greater elongation produces some grain distortion, and, eventually, the appearance of slip planes.

Only two men are required to operate the set-up. The sheets are delivered to the press brake trimmed to size, including the salvage strip. When the 90-degree clamps are used, the heavier sheet stock must have the salvage strip pre-formed to the curvature of the radius-bar. This is accomplished on a conventional press brake.

As far as is known, this is the first time equipment of this type has been employed in stretch-



**Fig. 2. Another type of clamp used on the modified press brake. With this clamp, the sheet is grasped at right angles to the direction of stretch, and a radius-bar eases the sheet into the plane of stretch**

**Fig. 3.** Two dial indicating gages show the hydraulic pressure on the press ram. Means are also provided for setting the distance the punch travels, tilting the punch, raising or lowering the stretch jaws, and controlling the air pressure

forming work. However, results obtained indicate that the modified press brake has many advantages which make it applicable for use in any industry where economical precision stretch-forming is required.

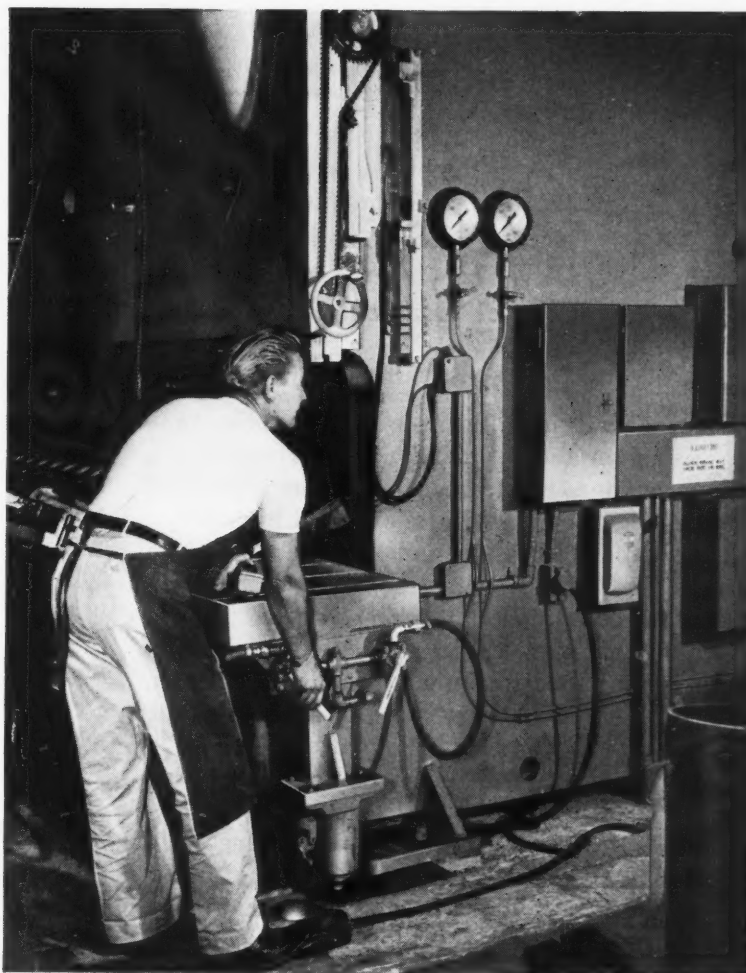
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### Machine Tools and Their Hazards

Accidents from machine tools can be avoided in many cases by properly guarding the machines and training the workers. In order to help reduce such accidents, the United States Department of Labor, Bureau of Labor Standards, Washington 25, D. C., has brought out a bulletin (No. 129) entitled "Machine Tools and their Hazards." This bulletin describes the general hazards of machine tools as a group and suggests how the use of these machines can be made safer. Another bulletin (No. 139) describes the hazards concerned with the operation of metal-forming, punching, and shearing machines.

Copies of these bulletins can be obtained from the Bureau of Labor Standards without charge

as long as the free supply lasts. Quantities may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. at 15 cents each for Bulletin 129, and 20 cents for Bulletin 139. A discount of 25 per cent is allowed on orders of 100 or more.



**Fig. 4.** A formed wing leading edge is shown being removed from the press brake. When elongation during stretching is maintained within 5 to 6 per cent, no cracked parts or springback results



# Welding and Brazing

Methods Recommended by the International Nickel Co. for Joining Nickel and High-Nickel Alloy Seamless Tubing by Arc, Oxy-Acetylene, or Inert-Gas Metal-Arc Welding; Silver or Copper Brazing; or Soft Soldering—Second of Two Articles

**I**N the first installment of this article, published in the August issue of *MACHINERY*, recommended methods for coiling, bending, threading, and expanding nickel and high-nickel alloy seamless tubing were described. Suggested means for joining such tubes are described in this installment.

Pipes and tubes of nickel, Monel, and Inconel are readily joined to similar parts or to headers, flanges, fittings, etc., by arc, oxy-acetylene gas, or inert-gas metal-arc welding; silver or copper brazing; or soft soldering. Before starting to weld or heat for bending, it is necessary to remove all foreign material, such as grease, oil, machining or threading lubricants, paint, marking crayons, or (in the case of used material) processing chemicals. Sulphur or lead has an embrittling effect on nickel and the high-nickel alloys at temperatures over 600 degrees F., and either, or both, is likely to be present in the materials mentioned. Heavy layers of oxide should be removed, as they may cause difficulty in the welding operation.

Although metal-arc welding is generally limited to pipe or tubing of over 2 inches outside diameter with wall thicknesses greater than 0.125 inch, it can be used for smaller sizes. No joint preparation is required for tubing having

wall thicknesses not exceeding 0.093 inch, but beveling to a 75-degree included angle is recommended for pipe and tube with heavier walls. A 1/32- to 1/16-inch square land, as seen in Fig. 1, should be left at the root to facilitate set-up. U-grooves may be used to advantage for extra or double extra heavy pipe with 3/8 inch or greater wall thickness. Suggested joints for welding tubes into tubesheets are shown in Fig. 3.

Spacing between tubes at the joint should be sufficient to permit complete, uniform penetration, but in no case should the sections be butted tightly before tack-welding. Enough gap should be left between the parts to allow for contraction of the tack-welds. If the parts are butted tightly, the shrinkage of the tack-welds will create a compressive force in the joint and cause incomplete or erratic penetration. Backing rings are not recommended, since they tend to increase the stress and provide focal points (crevices) for corrosion. The welding procedure and sequence given in Tables 2 and 3 also may be used for metal-arc welding of joints in the vertical position.

No preheating is required unless the ambient temperature is freezing or below, and then the joint need only be warmed to about 75 to 100 degrees F. All welding slag should be removed from each bead before the next bead is deposited.

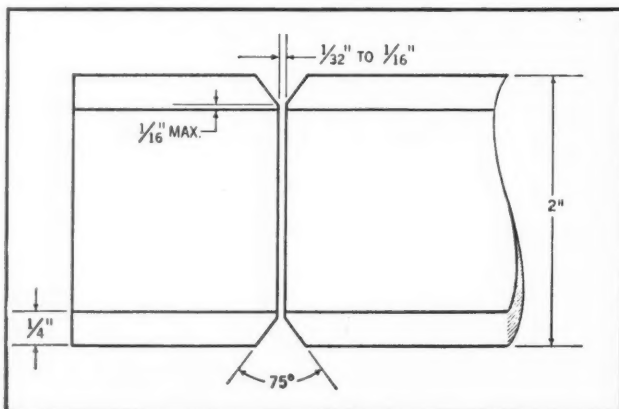


Fig. 1. Recommended joint for metal-arc welding of pipes and tubes of nickel, Monel, and Inconel. No joint preparation is required for tubing having wall thicknesses not exceeding 0.093 inch

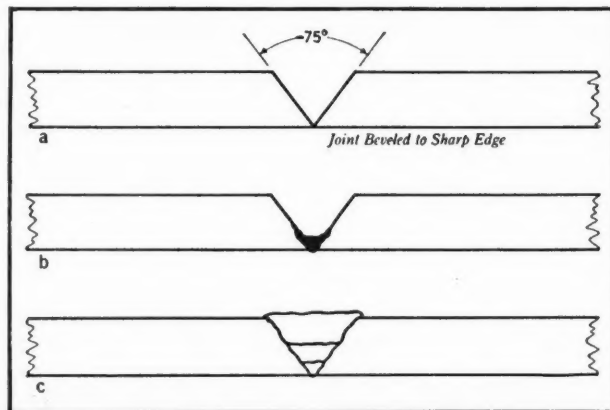


Fig. 2. Joint preparation for oxy-acetylene welding. With proper preparation, no filler metal need be added for the first bead. Second and successive beads are applied from bottom to top, as seen at (C)

# Seamless Nickel Tubing

Normally, stress relieving of welds in nickel, Monel, or Inconel is not done unless required by some code or specification.

## Welding Light-Wall Tubing by the Oxy-Acetylene Process

The oxy-acetylene process may be used for welding all pipe and tubing, but is especially recommended where the wall thickness is considered too light for metal-arc welding or where the diameter is less than 2 inches. Carbide used for the generation of acetylene is produced to a specification that permits up to 0.5 per cent sulphur, and it is possible to carry enough of this sulphur into the gas to cause embrittlement of nickel and high-nickel alloys. Therefore, tank acetylene is given a scrubbing treatment to remove sulphur before charging into the cylinders. Tank or bottled acetylene is recommended for the welding or silver-brazing of nickel and high-nickel alloys. Shop-generated acetylene should not be used for this purpose unless a scrubbing unit is available.

The oxy-acetylene flame should be adjusted to a slightly reducing condition. The amount of excess acetylene should only be sufficient to compensate for the normal regulator fluctuation and eliminate any possibility of the flame becoming oxidizing in nature. When it is necessary to use an excess acetylene flame longer than 1/16 inch to balance regulator fluctuation, the regulators should be overhauled. The joint preparation and design for oxy-acetylene welding is shown in Fig. 2.

Inco 2 flux, recommended for oxy-acetylene welding of Inconel, will give the best results when a 1 to 4 shellac-alcohol solution is used as a vehicle. Inco 3 flux, for oxy-acetylene welding of Monel, may be mixed with water. For oxy-acetylene welding of K Monel, one part lithium fluoride should be added to two parts Inco 2 or 3 flux. No flux is required for welding nickel. In cases where flux is needed, the proper flux should be mixed to a thin paste and applied to both sides of the joint and to the filler wire.

The best welding tip size to use is determined by experience, although the same size as is used for steel or one size larger, or a tip of similar thickness, will usually be satisfactory. Avoid puddling the weld. Excessive agitation of the weld puddle may result in porous or cracked welds. Monel and Inconel are quite fluid when molten, and nickel is relatively sluggish.

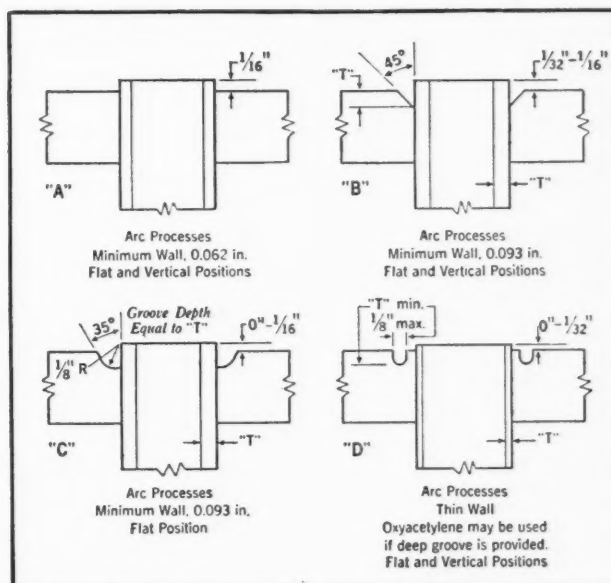


Fig. 3. Suggested joints for welding tubes into tubesheets. Joints (B) and (D) are preferred for vertical welding. Tubes should be lightly rolled both before and after welding, and tube ends should be reamed and beveled after welding

Complete penetration is desirable, as any unfused areas will, in some cases, result in early failure through accelerated corrosion or fatigue. The use of two beads or layers is recommended for all diameters and wall thicknesses. The first bead should be made from the top (12 o'clock) to the bottom (6 o'clock) in the case of fixed-position vertical welds.

If the pipe or tube ends are square and the proper fit-up and joint preparation have been made, as seen at *a* in Fig. 2, no filler metal need be added for the first bead. The edges of the

Table 1. Electrode Diameters for Tubing of Various Wall Thicknesses, Held in Different Welding Positions

Wall Thickness of Tubing, Inch	Welding Position		
	Rotated	Fixed, Horizontal	Fixed, Vertical
	Electrode Diameter, Inch		
0.065-0.083	3/32	0.075 or 3/32	3/32
0.095-0.125	1/8	3/32 or 1/8	1/8
0.134-0.187	1/8* and 5/32	1/8	1/8
0.200-0.312	5/32	1/8	1/8* and 5/32
Over 0.312	5/32 or 3/16	1/8* and 5/32	5/32

\*For first or root bead.

**Table 2. General Welding Procedure for Monel Tubing (ASTM Spec. B165)**

	Metal-Arc Process	Oxy-Acetylene Process*
Filler Material ...	130X Monel	40 Monel
Flux .....	.....	Inco 3
Power .....	Direct Current, Reverse Polarity	.....
Backing .....	None	None
Preheat .....	None	None
Postheat .....	None	None
Welding Position..	Pipe Horizontal and Joint Vertical	Pipe Horizontal and Joint Vertical

\*Flame should be slightly reducing, 1/16 inch excess acetylene feather.

joint are flowed together to obtain complete penetration, as seen at *b*. The second and successive beads should be applied in a normal manner from bottom to top, as seen at *c*, using the proper filler wire. The two-bead procedure is equally effective when used on joints that can be rotated.

#### ***Inert-Gas Metal-Arc Welding***

Inert-gas metal-arc welding may be used for joining all sizes and wall thicknesses of nickel and high-nickel alloy pipe and tubing. It is particularly well suited to the welding of thin-walled tubing joints in the pipe shop, where the joint can be rotated during welding. Moderate air movement in the shop, due to fans or welding generators, or in the open (wind) may disrupt the protective inert-gas blanket around the arc and cause porous welds. Under these conditions, the oxy-acetylene process is generally more practical and economical.

The joint preparation for inert-gas metal-arc welding (Figs. 1 and 2) and the need for cleaning are the same as for other welding processes. The joint preparation is governed by the diameter and wall thickness. High-purity welding grades of helium or argon should be used as a shielding gas, although helium will usually insure better weld soundness. Adequate gas flow must be maintained. Gas flow less than 10 cubic feet per hour may offer inadequate protection and result in porosity.

While alternating current with superimposed high frequency can be used, greater soundness and ease of handling will be obtained with direct current, straight polarity. Where the need for filler metal is indicated, Inco Series 60 wires are recommended. These wires will provide welds having mechanical and corrosion-resistant properties comparable to those of the base metal. They are especially suited for the production of sound welds, and should be used when the welding is to be done with manual equipment.

Welding should progress steadily without puddling, or agitating, the molten pool. A short arc should be maintained at all times, since the weld soundness will decrease as the arc length approaches or exceeds 1/16 inch in length. When service conditions require the elimination of all flux from the completed joint, the inert-gas metal-arc welding process is preferred to the oxy-acetylene or metal-arc processes.

#### ***Silver Brazing of Nickel Tubing***

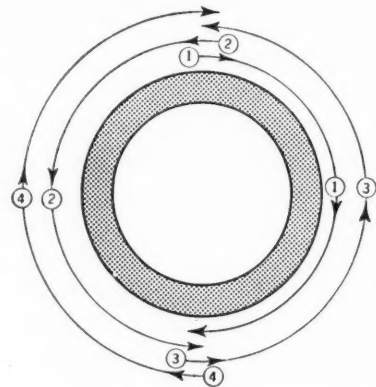
Silver brazing is useful for joining all sizes of Monel, nickel, and Inconel pipe and tubing when the corrosive environment and service temperature will permit the use of a silver-brazing alloy. The strength of silver-brazed joints in nickel and high-nickel alloys drops off sharply above 450 degrees F.

Lap or socket type joints are recommended for this process, and the amount of lap should be at least three to five times the wall thickness of the thinnest member. The fit of parts is important, and the clearance for the brazing alloy to flow through should be held to a minimum. When radial clearances of over 0.005 to 0.006 inch are employed, the strength of the joint will be only equal to that of the brazing alloy, or approximately 50,000 pounds per square inch. Maximum joint strengths are produced with approxi-

**Table 3. Details of Metal-Arc and Oxy-Acetylene Welding Procedures**

Pass No.	Metal-Arc Process		Oxy-Acetylene Process	
	Electrode Diameter, Inch	Current Range, Amperes	Filler Rod Diameter, Inch	Tip Size
1	1/8	85-95	*	4
2	1/8	85-95	*	4
3	1/8	80-90	3/32	4
4	1/8	80-95	3/32	4

\*No filler required on passes 1 and 2. Base metal to be fused to full depth of square land.



mately 0.002 inch radial clearance, but this size clearance is difficult to obtain in production.

Standard brazing fittings, valves, elbows, reducers, and other shapes are available. The brazing alloy may be fed by hand into the joint or replaced in the form of rings or other wire forms, or as foil. Any phosphorus-free silver-brazing alloy can be used on nickel and high-nickel alloys; however, an alloy of low melting temperature, such as those conforming to U. S. Navy Specification 47S13 (Int.), Grade IV, or A.M.S. Specification 4770A, is recommended to reduce oxidation or warpage during brazing.

When stress cracking is encountered with these alloys, and the stress cannot be removed, a cadmium-free brazing alloy is recommended. Stress may occur from cold work in the material, applied force during brazing, or differential thermal expansion caused by rapid heating. The joints must be free from oxide and all foreign material, and the cleaning operation should preferably be done just before assembly of the parts. All pieces should be fluxed liberally—both male and female—and assembled immediately. More flux is then applied to the exterior of the joint.

A moderately reducing oxy-acetylene flame should be used for silver brazing. The flux will serve to indicate the temperature, as it becomes a clear fluid at approximately 1000 degrees F. When the joint has been uniformly heated to the temperature where the flux is water-thin, a drop of the brazing alloy should be melted on the joint and the heating continued until this drop spreads. The heat is maintained at this temperature while application of the brazing alloy is completed. The flame should be used as a "brush," the heat being "brushed" into the joint. The flame should be kept in motion to avoid localized overheating. Residual flux, both inside and outside, is removed with boiling water.

#### ***Copper Brazing Requires Close Control of Clearances***

Copper brazing may be used to join assemblies of Monel, nickel, and Inconel tubes and pipes when the corrosive medium will permit the use of copper. Since copper brazing is done in a controlled-atmosphere furnace, assemblies must be of such size and shape that they will fit into available furnaces. Copper brazing requires close control of clearances. A light press fit to 0.002 inch gap on a side is the limit for successful brazing.

The chromium content of Inconel will cause difficulty in copper brazing. Therefore, Inconel parts are frequently given a copper plating when this process is to be used. The copper plate is

sometimes sufficient to supply the copper required to braze the joint. A bronze brazing flux may be needed in some cases for Inconel parts, in addition to the copper plating. In some instances, a very dry atmosphere (— 100 degrees F. dew point) may be employed to braze Inconel without the use of flux or copper plating.

#### ***Soft Soldering Employed for Low-Strength Requirements***

Soft soldering is sometimes useful for making joints in Monel, nickel, and Inconel pipe and tubing when the corrosive medium will permit and when the operating temperature is not above 212 degrees F. Joints made with soft solder are weak at their best, and lose their strength rapidly as the temperature is raised. Careful attention must be given to the support of soft soldered joints. They should not be expected to carry any of the service or line load.

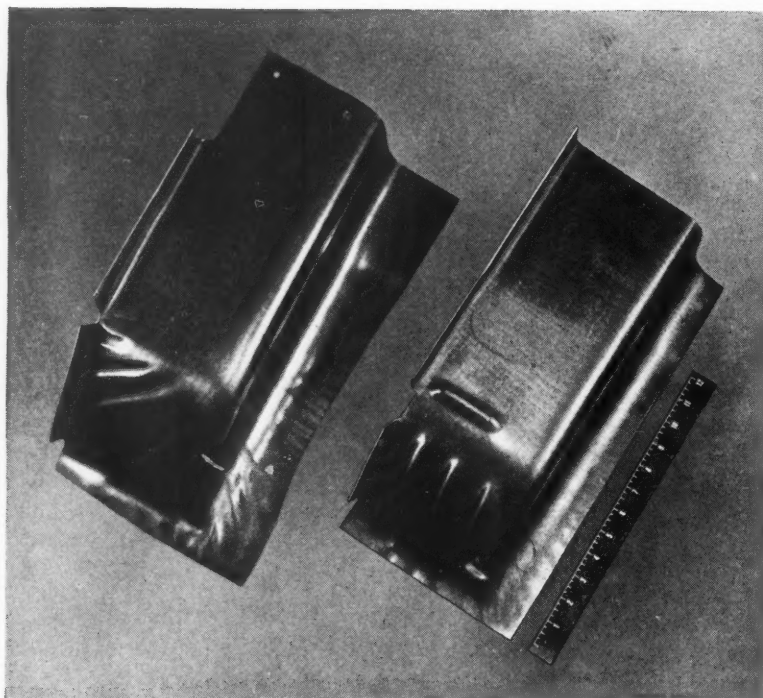
A pre-tinned lap or socket type joint is recommended for soft soldering, with the lap eight or ten times the thickness of the thinner member. Precleaning, as in silver brazing, is essential to satisfactory soft-soldered joints. Any good soft solder composition is usable, though solders of the higher tin content are to be preferred. Killed acid or a proprietary flux may be used with nickel or Monel. Rosin or rosin-alcohol mixtures are not suitable for these materials. Inconel requires a strong flux to remove the chrome oxide. Proprietary fluxes recommended for chromium-bearing materials should be used with Inconel.

Neither nickel, Monel, nor Inconel can be cut with conventional oxy-acetylene equipment. Mechanical separation with saws or friction wheels is preferred. The Linde Air Products Co.'s "Powder Cutting" or Arcos Corporation's "Oxy-Arc" processes may be employed, but all slag, burned material, or spatter resulting from the use of these processes must be removed prior to welding. Also, the surface preparation precautions previously noted should be observed prior to any thermal cutting operations.

\* \* \*

Declaring that the United States needs 5,200,000 additional skilled workers to meet the requirements of the defense production program, Charles E. Wilson, director of the Office of Defense Mobilization, said: "The handicapped have proved that their abilities outweigh their disabilities. To fail to put them to work on jobs for which they are qualified is a waste that this nation cannot afford."

# When Postformed Plastics



A Comparison between the Physical Characteristics and Applications of Laminated Plastics and Different Metals—Fourth in a Series of Articles

By WILLIAM I. BEACH  
Executive Assistant  
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Los Angeles, Calif.

**I**N previous articles, some of the forming and thermal characteristics of fully cured, "C" stage, thermosetting laminated plastics were described. The third installment, which appeared in May *MACHINERY*, covered methods of heating laminated plastics. This article will describe the engineering standards and design limitations of this material.

Preliminary design in all branches of engineering contemplates an accurate evaluation of many unknown quantities in terms of known facts. Therefore, since plastics are considered relatively new materials in the realm of engineering and design, the thermosetting group of the laminated materials can best be described by comparing them with aluminum alloys.

It should be understood that any comparison must be relative, because of the differences in the physical composition of these two materials. Aluminum is crystalline in structure; the thermosetting laminate is a built-up sheet comprising an amorphous binder and layers of fibrous filler. In the case of aluminum, a bend or draw is accomplished by a corresponding sliding of the crystals along slip planes. It may be said that slippage occurs along any of three axes, depending upon the direction of force causing distortion of the crystalline structure. Although

laminated plastics cannot be said to possess slip planes, they are not restricted to directional forming. Whereas aluminum deforms by slippage of crystals along planes of weakness, laminates deform by an incremental sliding and stretching of adjacent layers.

In forming aluminum, a draw or bend is generally accompanied by a reduction in thickness at the critical section. The thermosetting laminate does not give evidence of any reduction in thickness, and often indicates an increase in thickness at the critical section. As the adjacent layers of fabric stretch, the increase in section results from redistribution of the resin and crimpage of the warp and filler threads.

Due to the fact that 24S-O aluminum possesses a greater percentage of elongation than 24S-T aluminum, the former, softer material is usually employed for parts requiring deep-forming operations. In comparison, thermosetting laminates possess less than 1 per cent elongation in their original state as well as in the condition after postforming. Yet, when treated properly for forming, they will stretch as much as 9 per cent in either warp or filler direction, and in the bias direction, it is possible to obtain 15 to 25 per cent elongation. The strength of aluminum is increased by cold-working, and thermosetting laminates also increase slightly in strength as a result of such treatment. Postforming tends to improve some of the strength

Note: The Postforming Process is covered by United States and foreign patents, and pending applications are assigned to North American Aviation, Inc.

# Should be Employed

properties of laminated materials by further extending the polymerization, or cure, and by stretching the threads in the fabric.

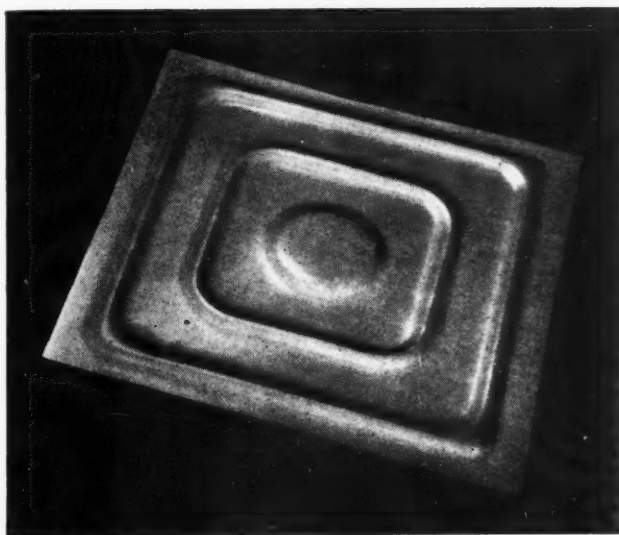
When metals are strained within their elastic limit, a return to the original shape occurs upon release of the deforming force. Consequently, press operations, such as bending and drawing, must deform the material beyond the elastic limit. This is known as the plasticity range. Repeated cold-working due to deformation, increases resistance to further forming action. Therefore, while aluminum is limited as to recurring bending or drawing operations the laminates may be formed and reformed a great many times. It is noteworthy that aluminum is formed in the plastic range and thermosetting laminates are formed in the elastic range. This

is due to the fact that, under proper conditions, the latter can be made to return to a close approximation of its original form without the aid of externally applied forces.

The engineering standards for the postforming process are similar and comparable to metal fabricating standards. Some differences exist, of course, between the two, but the fabricating technique is approximately the same. Thermosetting plastics cannot be welded, drawn quite so deeply, or bent so sharply as a few of the softer metals. Neither are they so susceptible to the action of compressibility, where the material shrinks on the compression side of the bend. The laminates differ in the foregoing respects and, therefore, the postforming standards provide other means for accomplishing the desired results. In general, however, the same procedures are followed in order to obtain beads, flanges, dimples, bending, or drawing.

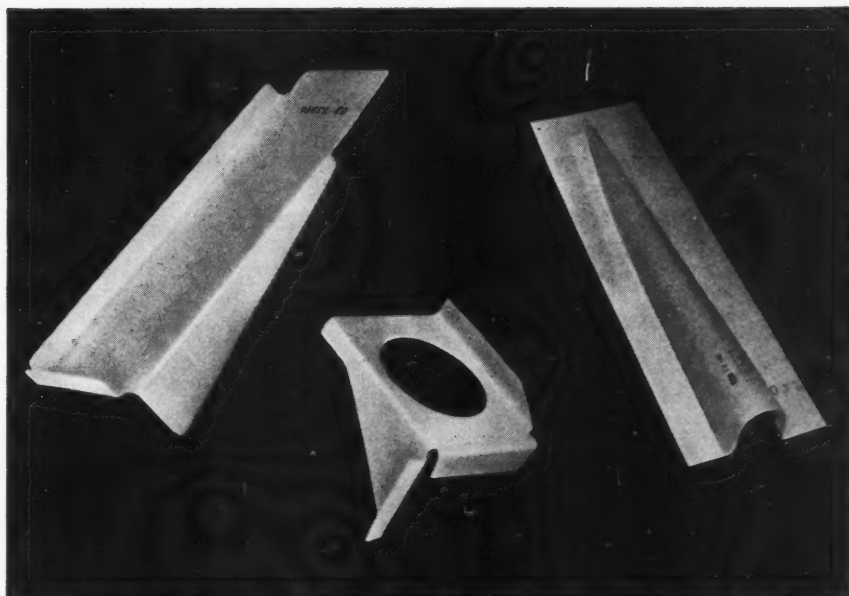
In Fig. 1 are shown three typical postformed parts on which simple bending and pressing operations have been performed. The panel seen in Fig. 2 has concentric beads which serve to stiffen the postformed part. It is customary in sheet-metal fabrication to incorporate beads in thin wall sections whenever permissible, in order to save weight and additional manufacturing costs. When structural requirements are more severe, rigid stiffening members, usually channels or L-shaped angles, are attached to the face of the part by rivets or welds.

A typical drawn plastic part is shown at the left in Fig. 3, and, for comparison of fabricating technique, an aluminum counterpart is shown at



**Fig. 1. (Right) Typical postformed thermosetting laminated plastic parts made by simple bending and pressing operations**

**Fig. 2. (Above) A postformed laminated plastic panel with concentric beads which serve to stiffen the sheet**



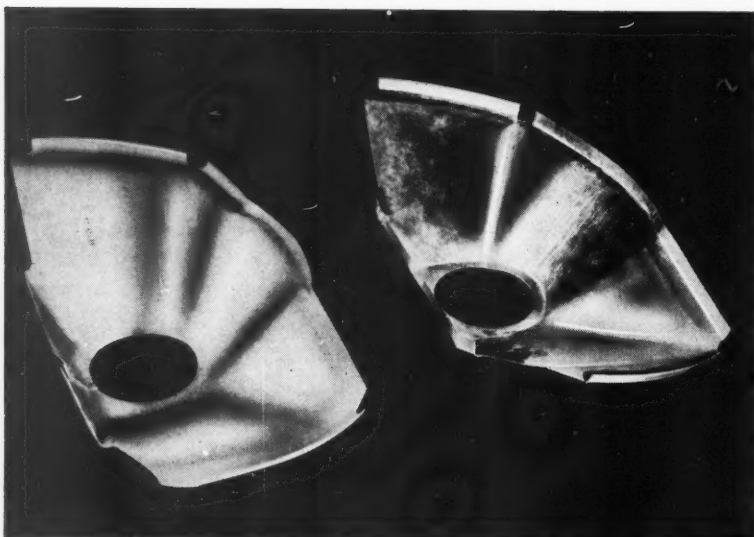


Fig. 3. Two ammunition case and link hoppers. The part on the left was made of 0.062-inch laminated, "C" stage fabric-base phenolic sheet, while the other was made of aluminum

the right. It will be noted that the laminated plastic hopper part is drawn in one piece, whereas the aluminum part is formed in two sections and seam-welded together. This does not mean that this metal part could not be drawn in one unit, but tooling difficulties and other practical considerations made it necessary to use the two-piece construction. Either part could have been produced by similar methods.

Another example of metal-forming versus postforming is illustrated in Fig. 4, where the feed chute shown at the left is a postformed laminated part, while that on the right is formed of steel. The fabrication of these parts is essentially the same, since the plastic chute is made with a riveted lap joint and the steel part has an outside spot-welded flange joint.

A good illustration of standard fabricating procedures is shown in Fig. 5. The part is a postformed laminated plastic ammunition box assembled with rivets. A longitudinal bead is pressed in the sides to provide stiffness. The ends are formed separately, and, in order to match the sides, relief slots are cut in the corners. These and other operations were done in accordance with usual metal-working standards.

#### *Applications and Advantages of Postformed Laminated Plastics*

Postformed laminates may be used for semi-structural or non-structural parts, such as ammunition boxes, feed chutes, case and link ejection chutes, cable guards, fillets and fairings, light brackets, and console parts. It is desirable to take advantage of the light weight, economy of manufacture, and the good abrasion and weather resistance of laminated plastics. Although the parts mentioned are representative of aircraft components, similar applications are recommended for many commercial and industrial needs.

Other physical characteristics of laminated postformed material which make it desirable over metal for certain secondary applications (within the operating temperature range of minus 65 to plus 160 degrees F.) are its resiliency, non-corrosiveness, and electrical resistance. The inherent corrosion resistance of the material eliminates the necessity of applying a protective finish. This provides a saving in the cost of the part. In Table 1 are listed some of the characteristics of laminated plastics. This

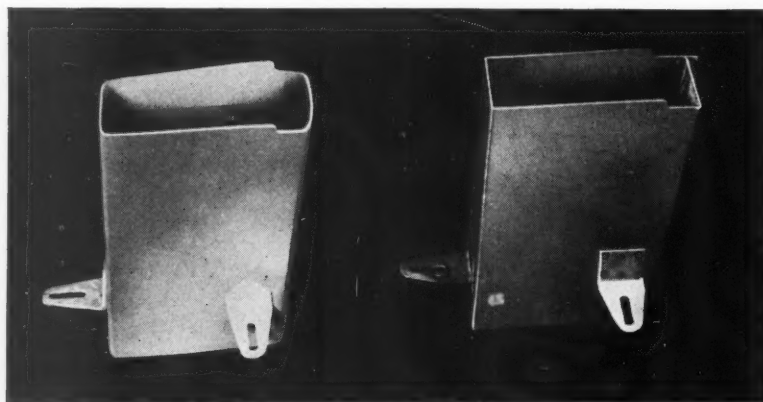


Fig. 4. Comparison between a laminated, canvas-base, "C" stage, postformed phenolic plastic part, at the left, and the same part made of steel, at the right

material is commercially available in sheet sizes up to 48 by 96 inches. Standard commercial thickness tolerances for various sheet thicknesses are listed in Table 2.

Industrial postforming fabric- and paper-base plastic sheet material is available in three colors—natural (tan), dark green, and black. Commercial postforming paper-base decorative sheet material is available in many colors and artistic design patterns. Laminated sheet is generally supplied with a satin finish. The machining of laminated plastic parts is similar to metal-working operations, and the tools and methods employed are interchangeable with little or no alteration.

The minimum bend radii for laminated postforming sheet are comparable to the softer aluminum alloys and annealed steels. In Table 3 are listed standard bend radii for laminated postforming plastic sheet and, for comparison only, various types of aluminum and steel sheets also.

The developed width of a formed plastic part,

Table 1. Characteristics of Postformed Laminated Plastics

Specific gravity .....	1.35
Weight, pounds per cubic inch.	0.049
Tensile strength (ultimate), pounds per square inch minimum .....	8000
Elastic modulus, tensile pounds per square inch .....	$1.25 \times 10^6$
Shear strength, pounds per square inch .....	9000
Bearing strength, pounds per square inch (based on deformation equal to 4 per cent of hole diameter) .....	20,000
Compressive strength (ultimate), pounds per square inch minimum .....	35,000
Flexural strength—flatwise—(ultimate), pounds per square inch .....	12,000
Impact strength, Charpy foot-pounds, unnotched .....	3.5
Effect on strength of elevated temperature (165 degrees F.)	
Tensile strength .....	10 per cent decrease
Impact strength .....	10 per cent increase
Maximum operating temperature, degrees F. ....	200
Dielectric strength	
Short-time volts per mil....	200
Step by step .....	100
Thermal coefficient of expansion, inch per inch per degree F....	$17 \times 10^{-6}$
Moisture absorption per cent per twenty-four hours, 1/8 inch thickness .....	4.5
Burning rate .....	Very low
Effect of sunlight and weathering .....	None to slight
Effect of weak acids.....	None to slight
Effect of strong acids	
Oxidizing acids .....	Decomposed
Reducing and organic acids..	None to slight
Effect of weak alkalis.....	Slight
Effect of strong alkalis.....	Decomposed
Effect of organic solvents.....	None



Fig. 5. This typical postformed part is a laminated plastic ammunition box assembled with rivets and provided with a longitudinal bead for stiffness

allowing for contraction of the material on the compression side of a bend (Table 4) may be determined as follows:

1. Add the over-all dimensions.
2. Subtract from the sum of the dimensions the value of bend deduction  $K$ , Table 4, corresponding to the inside radius of the bend and the thickness of the sheet.
3. The values  $K$  in the table represent the deduction for one angle. For more than one angle, multiply  $K$  by the number of angles.

For example, in the case of the part shown in Fig. 6, the dimensions 3/4, 3, and 1 inch are added together, giving a total of 4.75 inches. The sheet is 1/16 inch thick. Therefore, from Table 4, the value of  $K$  for this material with 1/8-inch radii is 0.135 inch. The part has two angles, resulting in a total bend deduction of 0.270 inch. This amount is subtracted from 4.75 inches, giving a developed width of 4.48 inches.

Table 2. Standard Commercial Tolerances for Laminated Postforming Plastic Sheet

Thickness, Inch	Tolerance, Inch
1/32	$\pm 0.0065$
3/64	$\pm 0.0075$
1/16	$\pm 0.0075$
3/32	$\pm 0.009$
1/8	$\pm 0.010$
5/32	$\pm 0.011$
3/16	$\pm 0.0125$
1/4	$+ 0.030 - 0.000$
1/2	$+ 0.048 - 0.000$

Referring to Fig. 7 and Table 5, the developed width, allowing for expansion of the material on the tension side of the formed part, may be determined as follows:

1. Add dimensions  $X$  and  $Y$  together.
2. Add to the sum of these dimensions the value  $J$ , given in Table 5, for the thickness  $T$  of the material and the radius  $R$  of the bend.
3. For more than one angle, multiply  $J$  by the number of angles.
4. Total developed length of the formed part equals  $X + Y + J$

where

$$X = A - (R + T)$$

$$Y = B - (R + T) \text{ and}$$

$$J = \text{bend allowance from Table 5}$$

Bend reliefs applicable in sheet metal practice may be used. Stiffening beads and flanged lightening holes may be formed in laminated postforming sheet 1/32, 3/64, 1/16, and 3/32 inch thick.

When thermoset, fabric-base laminated material is in a formable condition and subsequently stretched to increase its length, a corresponding reduction in width occurs. The allowable stretch in either warp or filler thread direction is approximately 10 per cent. The reduction in width is about 60 per cent of the increase in length. Accordingly, under favorable drawing conditions, the depth of draw obtained for any given shape and dimensions has a direct relation to the permissible degree of circumferential shrink in the material. However, other factors must also be taken into account with respect to the behavior of laminated materials during the drawing operation. There is an inherent tendency for the sheet to curl or roll, due to the lateral or compressive shrink forces.

**Table 3. Recommended Minimum Bend Radii for Laminated Postforming Plastic Sheet Compared with Other Materials (90-Degree Bends)**

Postforming Grades Laminated Plastic Sheet		Stainless Steel (One-Half Hard)		Low-Carbon Steel		24S-O Aluminum		24S-T Aluminum	
Gage	Radius	Gage	Radius	Gage	Radius	Gage	Radius	Gage	Radius
0.032	1/32	0.030	1/16	0.031	1/16	0.032	1/16	0.032	1/8
0.047	1/16	0.042	3/32	0.050	1/8	0.051	3/32	0.051	3/16
0.062	3/32	0.062	1/8	0.063	1/8	0.064	3/32	0.064	3/16
0.094	3/16	0.093	3/16	0.093	5/32	0.091	3/16	0.091	3/8
0.125	5/16	0.125	1/4	0.125	3/16	0.125	1/4	0.125	1/2
0.188	9/16	0.187	3/8	0.188	3/16	0.188	7/16	0.188	27/32
0.250	1	0.250	1/2	0.250	3/16	....	....	....	....
0.375	2 1/4	....	....	....	....	....	....	....	....

Note: All values given are in inches.

**Table 4. Amount to be Deducted (K) from Width of Sheet to Allow for Making 90-Degree Bends**

Radius of Bend	Thickness of Sheet						
	1/32	3/64	1/16	3/32	1/8	3/16	1/4
1/32	0.054	....	....	....	....	....	....
1/16	0.068	0.088	....	....	....	....	....
3/32	0.081	0.101	0.122	....	....	....	....
1/8	0.094	0.115	0.135	....	....	....	....
5/32	0.108	0.128	0.149	....	....	....	....
3/16	0.122	0.142	0.162	0.203	....	....	....
7/32	0.135	0.155	0.175	0.216	....	....	....
1/4	0.148	0.169	0.189	0.230	....	....	....
9/32	0.162	0.182	0.202	0.243	....	....	....
5/16	0.176	0.196	0.216	0.256	0.297	....	....
11/32	0.189	0.209	0.229	0.270	0.311	....	....
3/8	0.202	0.223	0.243	0.283	0.324	....	....
13/32	0.216	0.236	0.256	0.297	0.337	....	....
7/16	0.230	0.250	0.270	0.310	0.351	....	....
15/32	0.243	0.263	0.283	0.324	0.364	....	....
1/2	0.256	0.277	0.297	0.337	0.378	....	....
17/32	0.270	0.290	0.310	0.351	0.391	....	....
9/16	0.284	0.304	0.324	0.364	0.405	0.486	....
3/4	0.364	0.385	0.405	0.445	0.486	0.567	....
1.00	0.472	0.492	0.512	0.553	0.594	0.675	0.756

Note: All values given are in inches.

For example, as the sheet is drawn, it tends to conform to the shape of the plunger by stretching and sliding into the cavity of the die. Unless a restraining force is applied immediately after drawing commences in order to prevent the folding action of the material, wrinkles will build up rapidly and, hence, limit the depth of draw. Retaining or pressure plates are provided for this purpose to restrict the sliding sheet between parallel surfaces. The sheet should be maintained at a constant temperature throughout the drawing operation. This may be done by heating the plunger and pressure plates.

For simple shapes, such as a spherical-bottom cup, the limits of draw are relatively easy to determine. This is the standard shape used by North American Aviation, Inc., to evaluate the drawing properties of postforming laminates. While the resulting data may be used to determine the depth of draw for irregular and more complicated shapes, sufficient care and judgment must be exercised until more exact information is provided.

For circular shapes, the depth of draw may be determined as follows: Roughly, the depth of draw obtainable for 1/16-inch thick sheet material (assuming that the shape is a segment

of a sphere) equals one-third the diameter of the opening, or ( $h = d \div 3$ ). But as the shape becomes less dome-like and approaches a flat-bottom dish,  $h$  is influenced by a non-dimensional factor  $k$ , values of which are given in Fig. 8. Also, the depth of draw varies with thickness, which, in the case of postforming laminates, reduces about 3/16 inch for each 1/32 inch increase in thickness for sheets over 1/16 inch thick. The thickness factor is also limited to sheets between 3/64 inch and 7/32 inch.

For a quick, approximate estimate of depth of draw, the following formula may be used for certain limited shapes:

$$h = k (d \div 3) - (t - 0.0625) 6$$

where

$h$  = depth of draw;

$k$  = experimental constant;

$d$  = diameter of opening; and

$t$  = material thickness.

The use of special pressure hold-down plates to restrain laminated plastic sheet material between parallel plate surfaces throughout the drawing operation is very practical for the majority of drawn shapes. Some parts, however, may be made more economically, provided means can be taken to eliminate the pressure hold-down attachment. In this connection, recent development work has disclosed a method of utilizing beads effectively to displace excess material which otherwise would form wrinkles.

The ammunition bay liners shown in the heading illustration are typical drawn parts. It will be seen that the one at the left presents the usual wrinkled appearance expected when material is formed in a draw die without benefit of a pressure hold-down plate. The part seen at the right, which has a relatively wrinkle-free surface, was

**Table 5. Amount to be Added (J) to Sheet Width to Allow for Expansion in Making 90-Degree Bends**

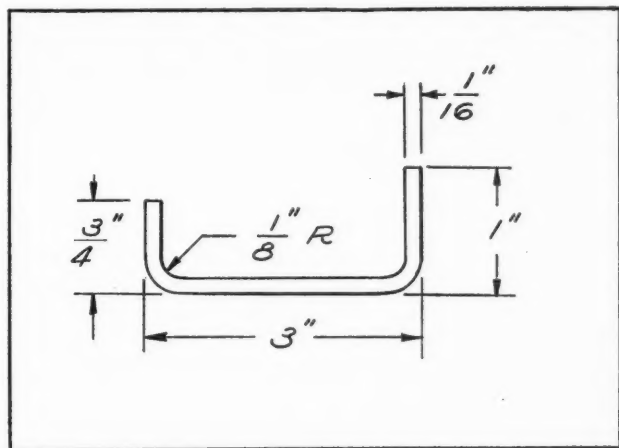
Radius of Bend	Thickness of Sheet						
	1/32	3/64	1/16	3/32	1/8	3/16	1/4
1/32	0.071	....	....	....	....	....	....
1/16	0.120	0.131	....	....	....	....	....
3/32	0.169	0.180	0.191	....	....	....	....
1/8	0.218	0.229	0.240	....	....	....	....
5/32	0.267	0.278	0.289	....	....	....	....
3/16	0.316	0.327	0.338	0.360	....	....	....
7/32	0.365	0.376	0.387	0.409	....	....	....
1/4	0.414	0.425	0.436	0.458	....	....	....
9/32	0.463	0.474	0.485	0.507	....	....	....
5/16	0.512	0.523	0.534	0.556	0.578	....	....
11/32	0.561	0.572	0.583	0.605	0.627	....	....
3/8	0.610	0.621	0.632	0.654	0.676	....	....
13/32	0.659	0.670	0.681	0.703	0.725	....	....
7/16	0.708	0.719	0.730	0.752	0.774	....	....
15/32	0.757	0.768	0.779	0.801	0.823	....	....
1/2	0.806	0.817	0.828	0.850	0.872	....	....
17/32	0.855	0.866	0.877	0.899	0.921	....	....
9/16	0.904	0.915	0.926	0.948	0.970	1.014	....
3/4	1.198	1.209	1.220	1.242	1.264	1.308	....
1.00	1.591	1.602	1.613	1.634	1.656	1.700	1.744

Note: Values tabulated are based on the empirical formula:  
 $\text{Allowance} = (0.01743R + 0.0078T \times \text{number of degrees in bend})$ .

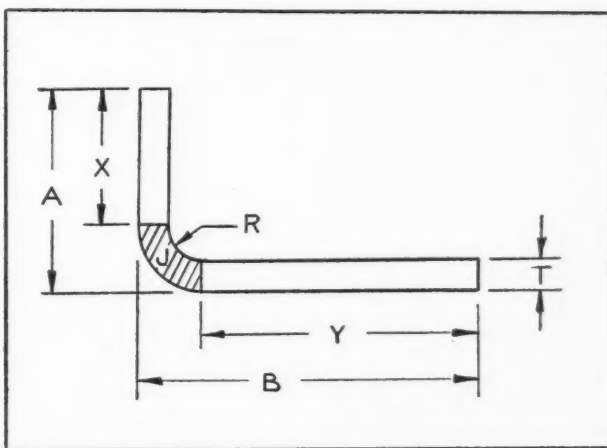
All values given are in inches.

obtained from the same die and, except for the addition of several bead-forming inserts to the die, no other means was used to control wrinkles. From a study of these two parts, it may be seen that the beads are located with respect to the direction of the wrinkles.

The practice of using beads greatly facilitates the forming of many parts which heretofore were considered impractical because of the wrinkling problem. In many cases involving compound curvatures, it has been difficult to conceive of an inexpensive method of postform-



**Fig. 6.** To determine the developed width of a formed plastic part, allowing for the contraction of material on the compression side of a bend, subtract from the sum of the dimensions shown, a value (K), Table 4, for the given bend radii and thickness of sheet



**Fig. 7.** To determine the developed width of a formed plastic part, allowing for the expansion of material on the tension side of a bend, a value (J), Table 5, for a given radius and thickness of material, must be added to the dimensions (X) and (Y)





VALUES OF K	
K	SHAPE
1.000	
0.80	
0.65	
0.40	

Fig. 8. For certain limited shapes, a quick approximation of a safe depth of draw may be obtained by using the experimental constant (k) given here

ing laminated plastic sheets. At best, it was usually necessary to design complicated tooling in order to obtain a part free from wrinkles. However, a careful selection of the type of beads and their location now provides a means to expand postforming into fields which formerly employed other methods of fabrication.

A typical example of this is the air inlet duct shown in Figs. 9 and 10, which is formed in a reverse curve. One end of the duct is square and the other is round. This part could not be formed in an ordinary male and female mold, because of the accumulation of excess material on the top and side near the square opening. The shape of this part does not lend itself to pressure plate arrangements, and, therefore, beads were used effectively to dispose of overlapping material.

Since wrinkles were present in the side as well as the top, and since it was not feasible to bead the side, it was found practical to use vee type beads on the top, as shown in Fig. 9. The greatest overlapping of material occurred at the inside top edge, as may be seen in the end view, Fig. 10. Hence, the beads were widened at the edge and extended flush with the side. Three beads were sufficient to accomplish the forming.



Fig. 9. (Left) Laminated plastic air inlet duct in which a reverse curve was formed. This part illustrates the effective use of beads to dispose of overlapping material

Fig. 10. (Above) Close-up view of plastic duct illustrated in Fig. 9, which shows vee-shaped beads widened at the edge and flush with the side

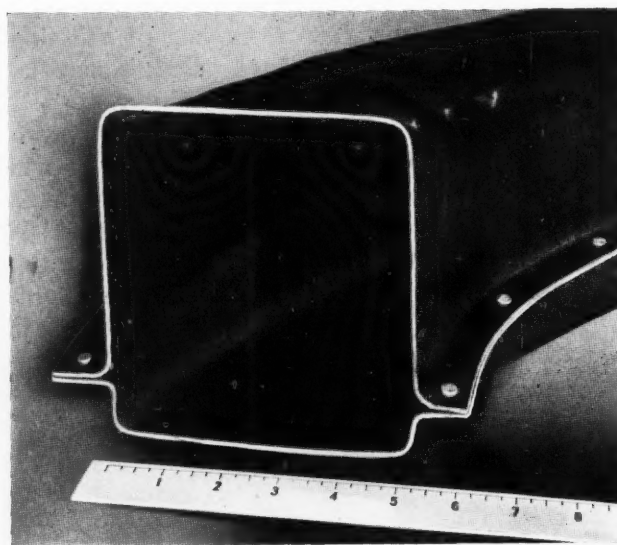
## Manpower Requirements of Machine Tool Builders

Secretary of Labor Maurice J. Tobin has announced that figures submitted at recent labor-management conferences on the machine tool industry show that employment in the industry is expected to expand by 50 per cent, or more than 40,000 workers, to meet an annual production rate of \$1,875,000,000.

Secretary Tobin said that defense orders amounting to \$2,900,000,000 are expected to be placed within the industry in the fiscal year of 1952. To meet its production schedules in 1951 and 1952, the machine tool industry will probably need an additional 500 mechanical engineers, 500 tool and die makers, 1000 foremen, more than 5000 skilled machine operators, and many more semi-skilled and unskilled workers.

\* \* \*

By the end of 1952, steel capacity in the United States will have increased about 36,000,000 tons, compared with 1940, or approximately 44 per cent. That increase exceeds the capacity of any other country in the world.



# Operator Carried around the Work in an Unusual Sand-Blasting Set-Up

**S**AND-BLASTING facilities by means of which the operator travels around large work in an air-conditioned cab are provided in a Pangborn Hydro-Sand blast room at the plant of the Falk Corporation, Milwaukee, Wis. The complete lay-out of the system is shown in Fig. 3. The blasting gun has turret action, and the cab on which it is mounted can be raised or lowered to blast all sides and crevices of intricate steel castings. Many angles of blast stream attack are available with this arrangement, and the use of a rotary work-table becomes unnecessary. Consequently, one operator is able to knock out cores and clean the surfaces of more castings than three operators previously had done. Also, a larger variety of castings can be handled and better work can be produced.

The present system replaced a conventional hydraulic sand-blasting installation in which the operators were dressed from head to foot in rubber clothing. Hoses to provide breathing air were attached to their helmets, and they were trailed by high-pressure water hoses and sand hoses. The operators handled guns having a capacity of only 30 gallons per minute of sand and water, under a pressure of 1800 pounds per square inch. This is the maximum pressure and rate of flow that can be manually held, and production was therefore limited by the operator's discomfort.

The Falk Corporation manufactures marine drives, speed reducers, flexible couplings, gears, weldments, and steel castings. The intricately cored castings range in weight from 75 to 90,000 pounds. Digging out the cores of such castings by conventional methods was a time-consuming operation. Accordingly, engineers developed the idea of running the operator and gun, in an air-conditioned cab, on a monorail around three sides of the room—taking the gun to the work

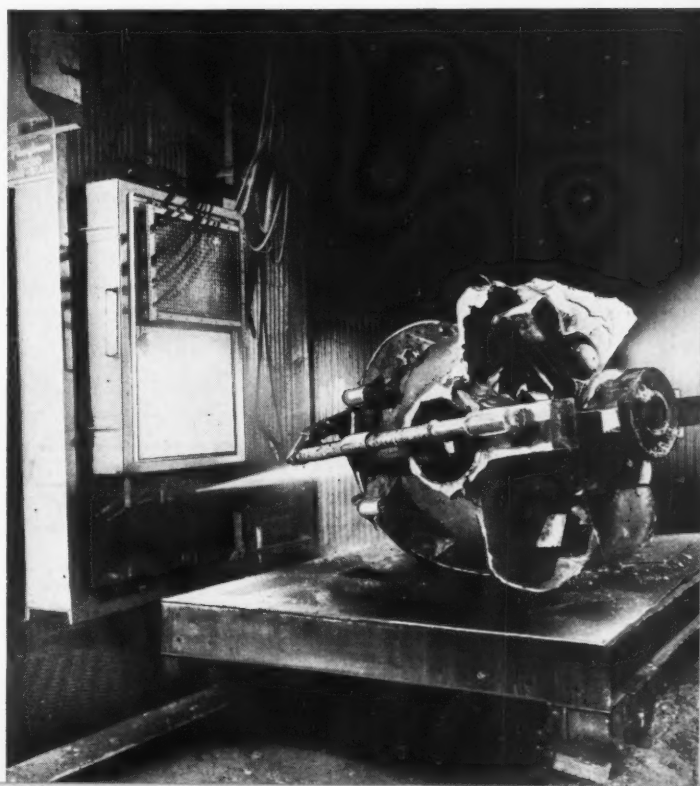


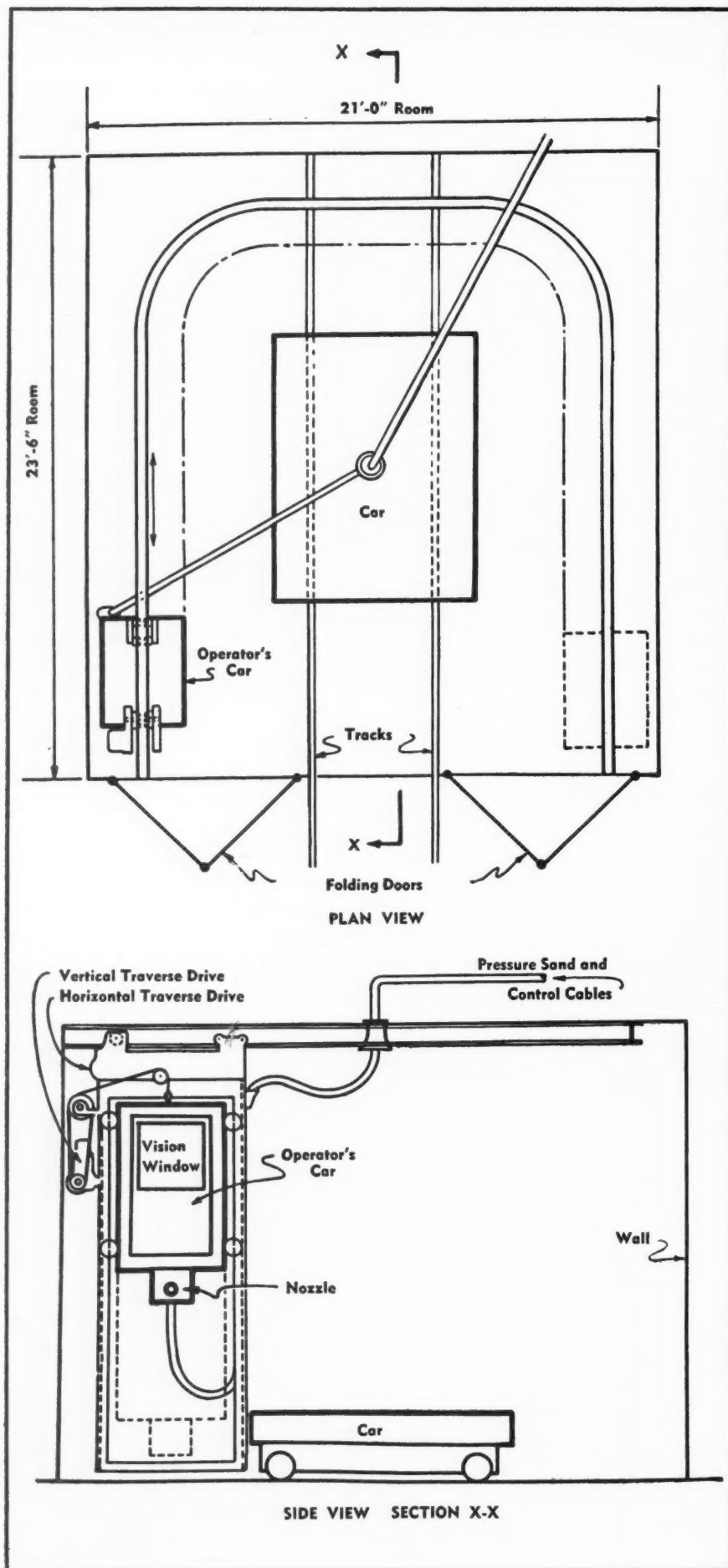
Fig. 1. Operator's car rounding a curve of the monorail in a hydraulic sand-blasting system. The car travels through an arc of 300 degrees around the castings while the operator moves the cab up and down and adjusts the nozzle to do the most effective cleaning job

rather than the work to the gun as is normally the case.

The Pangborn Hydro-Sand blast and core knock-out system consists of a steel room of suitable size, a complete electric control system, a high-pressure turret water gun, a sludge

Fig. 2. Cleaning and core knock-out operation on a large steel casting supported on the work-car. As the air-conditioned operator's car moves up and down and along the three-sided monorail, all crevices and sides of the casting are cleaned without operator fatigue or discomfort





pump, a classifier, and a blast sand tank. The cleaning and core knock-out operation takes place in the blast room, which is equipped with a bar-grated floor (see Figs. 1 and 2) through which spent sand and water drain off and drop through a chute to a scalping drum or vibrating screen. There the water and sand drop into the sludge tank, while tramp iron and nails fall into the refuse tank.

A special sludge pump then carries the water and sand to the classifier, where the sand is graded by an adjustable overflow weir and is passed to the blast sand tank. Excess sand is discharged to the reclaimer and skip, where it is permitted to drain naturally or is otherwise reclaimed. The operator, standing in the enclosed, air-conditioned car, controls the turret action of the nozzle through an angle of 50 degrees vertically and 60 degrees horizontally. By vertical movement of the car, the nozzle may be directed from heights ranging from 18 inches to 7 feet 8 inches. Horizontal travel of the cab around the three-sided monorail gives a 300-degree coverage of castings on the work-car.

Comparing the operation of this novel system to the old standard type of sand-blasting set-up, the advantages claimed for the new installation are:

1. The operator is dressed in normal clothing,

**Fig. 3.** Lay-out of three-sided monorail type hydraulic sand-blasting system. Note vertical and horizontal traverse mechanisms for operator's car. The car in the center supports castings to be cleaned

and therefore is able to work continuously rather than having to rest every couple of hours.

2. The new gun operates with 60 gallons per minute of sand and water under a pressure of 2000 pounds per square inch.

3. The gun is mechanically supported, and there is no strain on the operator.

4. It is practical to blast larger and longer castings than could be done previously.

Castings are decored and surface-cleaned in the new blast room prior to heat-treatment. Descaling after heat-treatment is done in Pangborn shot-blast rooms. The Hydro-Sand blast room is located in a side bay, which makes it necessary to provide a work-car, Fig. 2, to move castings into the room for blasting. There is no need for dust exhausting and collection.

\* \* \*

## Hydraulically Expanded Rubber Die Forms Airplane Fuel Tanks

Savings of 75 per cent in costs and 80 to 85 per cent in time are said to have been accomplished in fabricating aluminum jettisonable fuel tanks for the Air Force by the use of a novel metal-forming process. The new method, known as the Demarest process, is employed by the Vic Patushin Industries, Inc., Los Angeles, Calif. Sections for 230-gallon aluminum fuel tanks are formed in a single operation with this process at a production time of less than three minutes each, compared with fifteen to twenty minutes by spinning.

Using an elevating mechanism and an expanding rubber die, the process stretch-forms steel or aluminum cones and cylinders into forms with spherical contours, such as cowlings, propeller spinners, missile casings, and practice bombs.

The first step is to form a cone and seam-weld it by the Heliarc process. The cone is then placed inside a Meehanite die-holder, Fig. 1, weighing 3500 pounds and designed to withstand pressures of over 1500 pounds per square inch. Next, the rubber forming die is lowered into the sheet-metal cone, and with a steel lid securely locking the rubber forming die in place, Fig. 2, the die is expanded by pumping fluid from the reservoir until a pressure of 400 pounds per square inch has been attained. The expanding rubber of the die stretches the straight-sided cone into the curved shape desired.

After the fluid has been pumped out, the die lid is unlocked, the bag is lifted out of the die, and the formed part removed. Parts formed by this process require only one longitudinal seam weld, and are uniform in skin thickness.

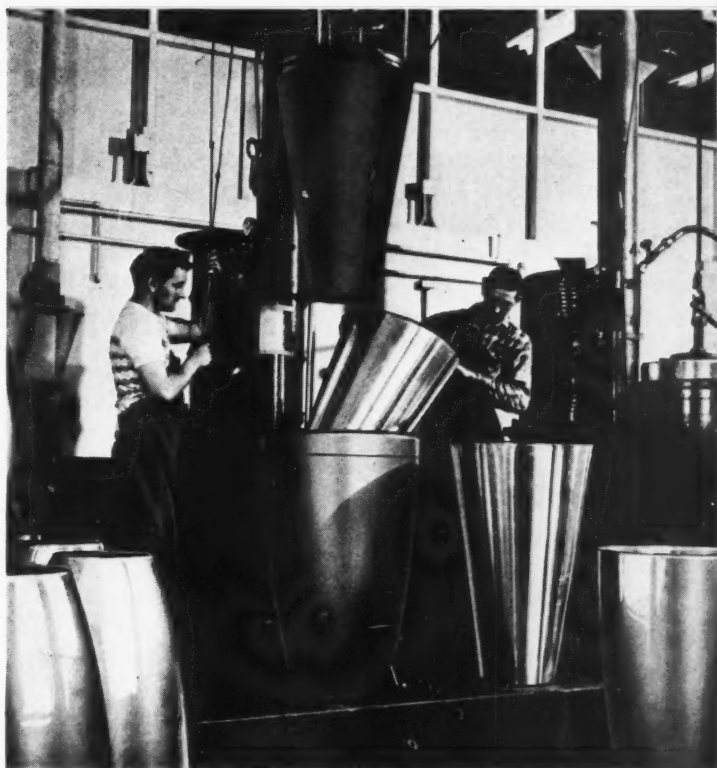


Fig. 1. A rolled and Heliarc seam-welded conical blank is fitted inside a Meehanite die-holder, and when the expanding rubber die descends, the straight-sided cone is formed into an aft section for a 230-gallon jettisonable fuel tank

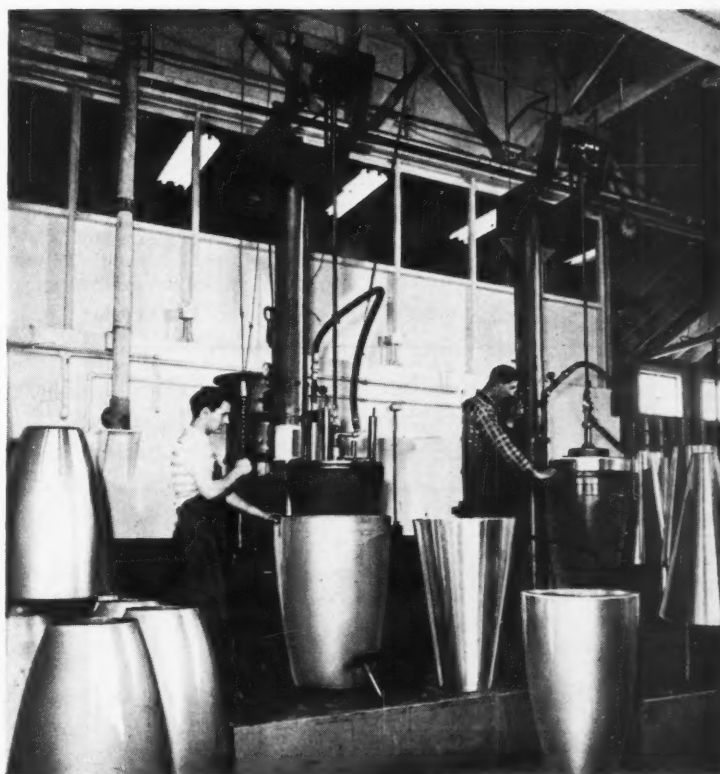


Fig. 2. With a steel lid securely locking the rubber forming die in place on the machine seen at the right, the die is expanded by fluid under a pressure of 400 pounds per square inch for forming

# Packings for Hydraulic

Packings for Hydraulic Presses, Machine Tools, and Other Equipment are Made in a Wide Variety of Types and Different Materials for Specific Purposes. Those that are Used Most Extensively are Described in this Article, Together with Recommended Applications — First of Two Articles

**T**HE leak-proof operation of industrial hydraulic equipment requires the careful selection of packing, or seals, since no one particular type is best for all applications. It is essential to consider the particular qualities required in a seal for each individual job. Used extensively in pumps, rams, cylinders, and other parts of hydraulic equipment for sealing joints to prevent the leakage of oil, water, and other fluids, packings are made in a great variety of types and materials. The material used, of course, depends upon the class of service for which the packing is to be employed. Whatever the composition may be, however, the essential qualities for most industrial applications are elasticity, durability, and in the case of moving parts, a low coefficient of friction, with practically no wearing or abrading effect.

**Table 1. Recommended Clearance between Piston and Cylinder When O-Ring Packing is Used Under Various Pressures**

Pressure on O-Ring Packing, Pounds per Square Inch	Clearance, Inches
0 to 500	0.008 to 0.010
500 to 1500	0.003 to 0.006
1500 to 3000	0.001 to 0.003

**Table 2. Friction Pressure, in Pounds, Exerted on O-Rings of Varying Hardness at Different Working Pressures\***

Working Pressure, Pounds per Square Inch	Hardness		
	70 Shore	80 Shore	90 Shore
0	4	7	9.5
250	8	11	13.5
500	11	14	16.5
1000	17	20	22.5
2000	24	27	29.5
3000	29	32	34.5

\*Based on use of O-ring 11 inches in diameter, with 1/8 inch diameter cross-section.

Packings may be divided into two general classifications—static and dynamic. In the first group are those that form a seal between two surfaces that have no relative motion, as in cylinder heads or oil-pan gaskets. This type of seal is generally applied only where light pressures are encountered. In the examples mentioned, the packing is held between two surfaces by means of mechanical pressure, and the effective area sealed is that within the center line through the bolts.

## *O-Ring Seals Used for Static Applications*

Another type of static seal is confined in a groove, where the holding pressure is a little more than the product of the liquid pressure to be retained and the area within the exposed surface of the packing. Molded O-ring seals are typical of packing installed in this manner. Although they are widely used as dynamic seals, they are especially good in static applications, where they have an indefinite life. These seals have a circular cross-section and are generally housed in rectangular or vee grooves. They are very dependable because of their simplicity and ruggedness, and will seal at high pressures even when the sealing surfaces are slightly irregular.

The cost of O-ring seals is generally low, and they are easy to apply, permit simple construction in a limited space, and are available in a wide range of sizes and materials. The material selected for a particular application should be one that does not soften as a result of contact with the hydraulic fluid used, and it should provide maximum resistance to wear.

A typical example of static O-ring application is at the junction of the tubing with a cylinder head and cap. In these cases, the O-ring should be located on the inside of the tube, so that under repeated stress or shock, considerable distortion of the head, cap, and tie-rods or bolts can occur without leakage.

In dynamic applications, the sealing quality of O-rings is due to a sliding and squeezing action against the surfaces contacted. Under

# Equipment

By GEORGE N. DORR, President  
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high pressures, distortion of these rings adds to their sealing efficiency.

The life of O-rings depends largely upon the quality of the machined surfaces with which they are in contact and upon the closeness of the fit between the mating members. Usually these surfaces are polished, burnished, or honed, and the tolerances between mating members are held as close as possible. Chromium-plated surfaces add considerably to the life of the packing. It has been found that aluminum, brass, bronze, and stainless-steel surfaces have a tendency to cause excessive friction with these seals.

O-ring seals should not be used in applications where they may have to cross open ports or cor-

ners under pressure, and some means should be provided for lubricating them with grease unless the hydraulic fluid employed fulfills this requirement. They should never be forced over threads or rough surfaces, because the resulting scratches impair their sealing quality. Also, they should not be compressed more than 10 per cent of their cross-sectional thickness, since further reduction results in excessive friction and, of course, a shortened life.

Practically the same precautions are necessary for O-ring seals used on rotating shafts as for those employed on reciprocating parts. They are not recommended for continuous rotation, except at low rubbing speeds. Seals having a

Table 3. Depth, Width, and End Clearance of Hydraulic Piston-Rings of Various Sizes, and Number of Rings Required at Different Pressures

← PRESSURE  
SINGLE ACTING RAMS

← MAJOR PRESSURE  
DOUBLE ACTING RAMS

Ring Size, Inches	Minimum Groove Depth B, Inches	Minimum Groove Width C, Inches	End Clearance, Inches	Number of Rings Required per Ram at Specified Pressures in Pounds per Square Inch				
				1000	1500	2000	2500	3000
2 by 1/8	0.106	0.125	0.002 to 0.012	2	2	2	2	2
3 by 1/8	0.154	0.125	0.002 to 0.012	2	2	2	2	2
4 by 3/16	0.186	0.1875	0.003 to 0.013	2	2	2	2	3
5 by 3/16	0.220	0.1875	0.003 to 0.013	2	2	2	3	3
6 by 1/4	0.251	0.250	0.003 to 0.013	2	2	3	3	4
7 by 1/4	0.285	0.250	0.004 to 0.014	2	2	3	4	4
8 by 5/16	0.318	0.3125	0.004 to 0.014	2	3	3	4	5
9 by 5/16	0.349	0.3125	0.004 to 0.014	2	3	4	4	5
10 by 3/8	0.380	0.375	0.004 to 0.014	2	3	4	5	6
11 by 3/8	0.411	0.375	0.005 to 0.020	2	3	4	5	6
12 by 7/16	0.441	0.4375	0.005 to 0.020	2	3	4	5	6
13 by 7/16	0.471	0.4375	0.005 to 0.020	2	3	4	5	6
14 by 1/2	0.499	0.500	0.005 to 0.020	2	3	4	6	6
15 by 1/2	0.528	0.500	0.005 to 0.020	2	3	5	6	7
16 by 1/2	0.559	0.500	0.005 to 0.020	2	4	5	6	7
18 by 5/8	0.610	0.625	0.005 to 0.020	2	4	5	6	7
20 by 5/8	0.662	0.625	0.005 to 0.020	3	4	5	6	8
22 by 5/8	0.714	0.625	0.005 to 0.020	3	4	5	7	8
24 by 3/4	0.766	0.750	0.005 to 0.020	3	4	5	7	8
26 by 3/4	0.817	0.750	0.005 to 0.025	3	4	6	7	8
28 by 3/4	0.866	0.750	0.005 to 0.025	3	4	6	7	9
30 by 7/8	0.917	0.875	0.005 to 0.025	3	4	6	7	9
32 by 7/8	0.967	0.875	0.005 to 0.025	3	5	6	8	9
34 by 7/8	1.016	0.875	0.005 to 0.025	3	5	6	8	9
36 by 7/8	1.065	0.875	0.005 to 0.025	3	5	6	8	9

Compiled by American Hammered Piston Ring Co.

hardness above 80 Shore Durometer have less tendency to stretch or bunch up during rotation than do softer seals.

The friction of moving O-ring seals is primarily dependent upon the hardness of the seal, the amount of its compression, the fluid pressure, and the size of the seal. In specific installations, it is necessary to take into account such considerations as seal and cylinder material, the type of surface, degree of lubrication, and the speed of motion. Since even the closest production tolerances permit a wide variation in friction, caution is required in applying O-ring seals where extremely low friction is necessary.

It has been recommended, for best results in general applications, that the width of groove in a piston should be 1 1/2 times the diameter of the cross-section of the O-ring, and that the depth of groove be 90 per cent of this diameter. Small radii should be machined on the edges of

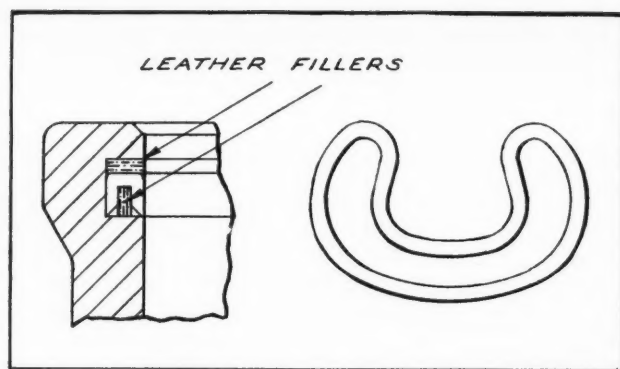


Fig. 1. Partial section through a cylinder, showing U-packing with shoulder pad and filler. At right is folded form recommended for installing U-packing

the grooves, and the side walls should slope at an angle of about 5 degrees. Recommended clearances between pistons and cylinders where O-rings are used under various working pressures are given in Table 1, and friction pressure under different working pressures exerted on O-rings of various degrees of hardness is given in Table 2. The figures given in the latter case are based on the use of an O-ring 11 inches in diameter with 1/8 inch diameter cross-section.

Table 4. Standard Packing Sizes

Cup Packings			
A	B	C	D
1 to 2	To Suit	1/2	3/32
2 to 3	To Suit	5/8	1/8
3 to 4	To Suit	5/8	5/32
4 to 5	To Suit	5/8 to 3/4	5/32
5 to 8	To Suit	3/4	3/16
8 to 10	To Suit	7/8	3/16
10 to 12	To Suit	1	3/16
U-Packings			
A	$\frac{B-A}{2}$	C	D
1 to 2	3/8	3/8 to 7/16	3/32
2 to 3	7/16	7/16	1/8
3 to 4	1/2	1/2	1/8
4 to 5	1/2	5/8	5/32
5 to 7	5/8	3/4	5/32
7 to 10	5/8	7/8	3/16
10 to 16	3/4	1 to 1 1/8	3/16
16 to 20	3/4	1 1/4	3/16

Note: All tabulated data given in inches.

### Various Types of Dynamic Packings

Dynamic packings, as previously mentioned, are those employed to prevent the leakage of fluid between two surfaces that have relative motion. The motion may be in alignment with the axis of the seal, as in the case of a reciprocating piston in a cylinder, or it may be at right angles to this axis, as in rotating members of hydraulic equipment. Among the various types of dynamic seals are washers, cups, O-rings, flanges, and U- and chevron or vee packings.

Metallic, as well as non-metallic, seals are used for many specific applications. Automotive piston-ring seals, for example, are employed in many hydraulic cylinders, and are excellent where high temperatures are encountered. Styles of face vary with different applications; straight and beveled cuts are used for low pressures, and step type cuts where relatively high pressures are required. Piston-rings are a good means of sealing a member that must pass over open ports. Table 3 gives end clearances and other data for standard commercial rings of various sizes.

Other metal packings include circular washers and flake material. Circular, soft-annealed metal washers, for static seals, are available in solid form, as well as in crimped sheet metal with asbestos or leather filler. Those that have asbestos filler are used for high-temperature applications. Made of aluminum, lead, or cop-

per, these washers are thin, and are generally confined in grooves that are not necessarily machined to a high finish.

Surfaces contacted by both faces of the washers should have mating circular V-grooves in them, so that the washer may be upset with a minimum of pressure. If a leak occurs at such a joint, the washer must be replaced unless additional bolt pressure stops the leak. Metal flake packings have a very limited use in industrial hydraulic equipment, being employed mainly for temporary repairs when the hydraulic fluid is hot or dirty or when one of the moving members to be sealed is scored.

### Applications of Cup Seals and U-Packing

Probably cup seals are used more than any other type in piston and cylinder applications. Made of high grade leather, properly impregnated, these and U-seals, Table 4, make excellent general-purpose packings. They provide smooth, chatter-free operation, even with light loads and feeds. Care should be exercised in applying a

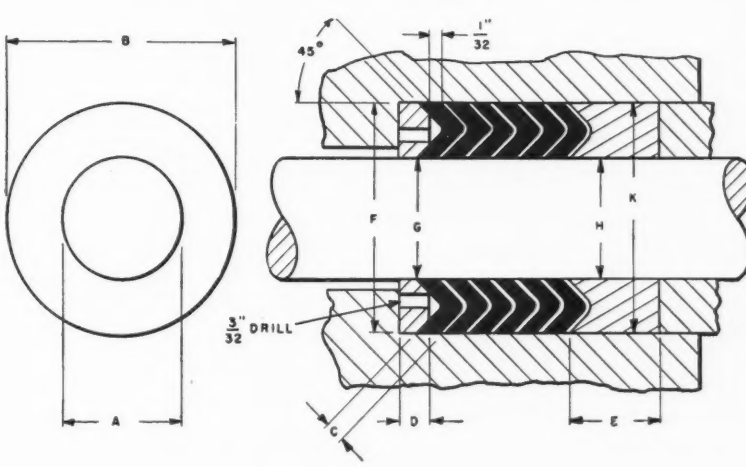
cylinder with leather cup type piston seals because cup pull-out and short life may result from improper specifications and design.

Sometimes U-packing is placed in a well machined recess, or stuffing box, to seal the reciprocating member of a hydraulic assembly. The sealing edges face in the direction from which pressure is applied, and the legs are free to expand under pressure, thus sealing inside and outside peripheries of the assembly. In such assemblies, the supporting gland should be drawn tightly to present a flat surface to the packing, and the U-seal should be a close fit around the ram and in the box.

When a metal filler is used between the legs of the U, it should be a snug fit, so that it will not move when pressure is applied or removed. In most applications, the best filler is a scalloped leather ring that fills the space between the legs and extends beyond their beveled edges.

Flax, hemp, or other fillers that expand in contact with hydraulic fluids should not be used, because their expansion causes pressure to be exerted against a moving member when the

Table 5. Recommended Sizes of Metal Spacers for Use with Various Sizes of V-Packings

								
Packing Dimensions					Metal Spacers			
A	$\frac{B-A}{2}$	C	D	E	F	G	H	K
1 1/2	1/4	3/32	3/16	1/4	B - 0.002	A + 0.002	A + 0.002	B - 0.002
1 5/8 to 2 1/2	5/16	3/32	7/32	3/8	B - 0.003	A + 0.003	A + 0.003	B - 0.003
2 5/8 to 4	3/8	3/32	1/4	3/8	B - 0.004	A + 0.004	A + 0.003	B - 0.003
4 1/8 to 6	7/16	1/8	3/8	7/16	B - 0.005	A + 0.005	A + 0.004	B - 0.004
6 1/8 to 10	1/2	1/8	7/16	1/2	B - 0.006	A + 0.006	A + 0.005	B - 0.005
10 1/8 to 13	9/16	1/8	1/2	9/16	B - 0.008	A + 0.008	A + 0.005	B - 0.006
13 1/8 to 16	5/8	5/32	5/8	5/8	B - 0.010	A + 0.010	A + 0.006	B - 0.006
Over 16	3/4	5/32	3/4	3/4	B - 0.015	A + 0.015	A + 0.006	B - 0.008

Note: For 500 pounds per square inch pressure, use four packings.  
For 1000 pounds per square inch pressure, use six packings.  
For 2500 pounds per square inch pressure, use eight packings.  
All tabulated dimensions given in inches.

working pressure is removed, thereby producing excessive friction. If packing of this type is placed in a recessed groove, it should have a shoulder pad and filler, as shown in Fig. 1. This will restrict movement of the packing and prevent excessive wear at the heel.

To insert U-packing into a recess of this type, it should first be made pliable and then bent to the shape illustrated. When it is in place, the inside leg may be opened and the filler applied. The shoulder pad shown can also be employed when a ram is a loose fit in the cylinder or when the height of the recess is too great.

Generally, U-packings are made from circular pieces of material. In the case of extra large sizes, when the packing is made of strip material, the joined ends may be glued together with a scarfed joint, or a long scarf joint alone may be used. Although care must be taken in the application of U-packings of the latter type, good service is usually obtained because they are invariably made of materials having uniform thickness and strength.

Table 6. Standard Packing Sizes

## Flange Packings

The diagram shows a cross-section of a flange packing. It is a U-shaped component with a central hole of diameter D. The total width of the flange is B, and the height of the packing is C. The width of the packing itself is A. The outer edges of the packing are chamfered at a 30-degree angle.

A	B (Min)	C	D
1 to 2	$A + 5/8$	$1/2$	$1/8$
2 to 3	$A + 3/4$	$5/8$	$5/32$
3 to 4	$A + 7/8$	$5/8 \text{ to } 3/4$	$3/16$
4 to 5	$A + 7/8$	$3/4$	$3/16$
5 to 7	$A + 7/8$	$3/4$	$3/16$

## Double-Flange Packings

The diagram shows a cross-section of a double-flange packing. It consists of two U-shaped components, one on top of the other, with a central hole of diameter D. The total width of the flange is B, and the height of the packing is C. The width of the packing itself is A. The distance between the two flanges is E.

A	B (Min)	C	D	E
1 to 2	$A + 3/4$	$9/16$	$1/8$	$1/2$
2 to 3	$A + 7/8$	$11/16$	$5/32$	$5/8$
3 to 4	$A + 1$	$11/16$	$3/16$	$5/8$
4 to 5	$A + 1$	$13/16$	$3/16$	$3/4$
5 to 7	$A + 1$	$13/16$	$3/16$	$3/4$

Note: All tabulated data given in inches.

### Points to be Observed in Applying V-Packing

Chevron or vee packing is also widely used for sealing members of hydraulic equipment. It may be made in solid rings, principally used with revolving parts, or split to facilitate application. When split rings are used, the split ends should be staggered in the stack. Because these seals are generally stacked in a packing chamber, the several sealing lips provide a very efficient means of preventing leakage.

When new V-packing is being installed, the gland should be tightened and then released, after which it is tightened again to a less degree, so that it is a little more than finger-tight. When clamped together too tightly, the V-packings act as compression packings, and have all the disadvantages of this type of seal.

Often it will be found that old rings need not be replaced unless they are damaged or completely worn out, as a leaking gland may be made liquid-tight merely by adding one or two new rings. Sometimes when presses that have U, cup, or flax packings are being overhauled, it may be found that replacing these seals with 90-degree V-packing will eliminate the need for re-machining the members to be sealed. The 60-degree V-packing is more sensitive and seals quicker, with less adjustment, than the more open 90-degree V-packing, although the latter is widely used with excellent results. Well made V-packings seal without leakage for long periods of time, and have been used with great success on water and oil under the highest pressures in common use.

This type of packing should be supported by metal rings. Such rings do not have to be replaced every time new packing is applied, as is the case with plastic or similar rings. The 60- and 90-degree V-packings operate with true automatic lip sealing, and will often overcome such imperfections as scores and cylinder markings. They seal perfectly in cases where U-packings fail, due to the fact that V-packings have multiple lips, whereas flange and U-packings only have one. The factor of safety, as far as sealing is concerned, is much greater with V-packings than with flange or U-packings. Table 5 gives recommended sizes of metal spacers for use with V-packings of different sizes.

Various forms of V-packings are commercially available. In some cases, complete sets consist of a minimum of three V-packings and a top and bottom adapter, ready for installation. Two of the V-packings are leather, treated for the service required and also to provide lubrication, while the other is molded synthetic rubber for sealing purposes.

Fig. 2. Cross-sectional diagrams of beveled, split-ring leather washers used for relatively high working pressures

The selection of any particular design must be carefully considered in relation to the assembly in which it is to be used because variations in design may make one less suitable than another for any particular job. Some forms of molded V-packing are very large in cross-section, so that the number that can be used in a particular recess is reduced. This, of course, decreases the number of sealing lips and places more pressure on each. In a number of designs, considerable space is allowed between each seal, thus facilitating deformation of the packing under some conditions and resulting in poor sealing.

Sometimes the cross-section of the packing is very small at the junction of the two legs, so that a hinge action is encouraged. When pressure is applied at the beveled faces of the legs, the thin section at the junction is compressed, forcing the legs inward toward the junction. This withdraws the sealing lips from the surfaces they should contact, allowing considerable leakage.

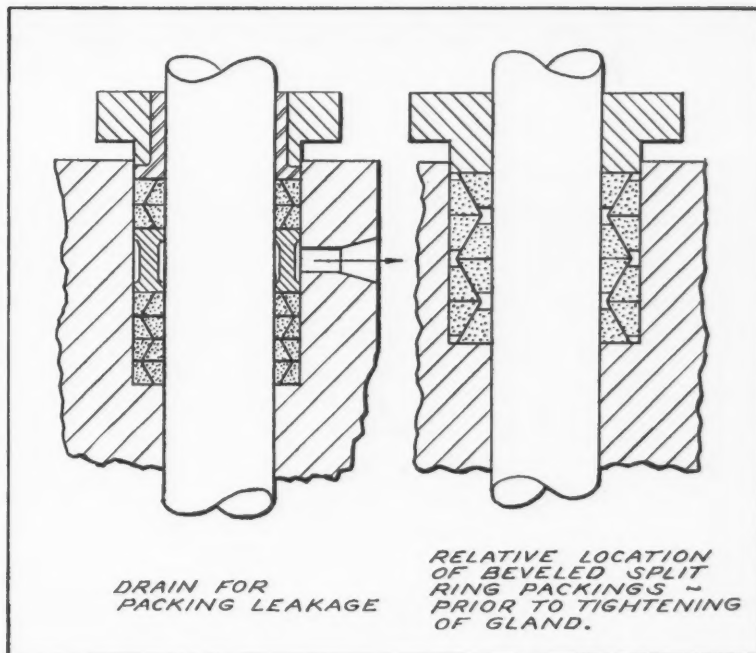
#### **Characteristics and Uses of Flange Packings**

Another type of seal widely used in industrial hydraulic applications is the flange packing. This is used principally for sealing small-diameter rods or as dust seals for revolving members. Metal surfaces in contact with the flat flange section should be provided with circular V-grooves, and if the packing is contained by a part that is bolted to the assembly, a metal washer should be placed between the packing and the nut.

Sealing action in this type of packing is obtained by the compression of the beveled edges against the surface to be sealed. A flange packing on a piston-rod acts similarly to a cup packing inside the cylinder barrel, and the advantages are identical. Properly designed flange packings will give leak-proof, non-adjustable operation over long periods of time, and provide a good general-purpose seal. Table 6 shows a few of the standard sizes available in this type of packing.

#### **Flax and Leather Packings Used for Low-Pressure Applications**

One of the most inexpensive forms of packing is hemp or flax, wound on spools. This sealing medium is sometimes impregnated with graphite



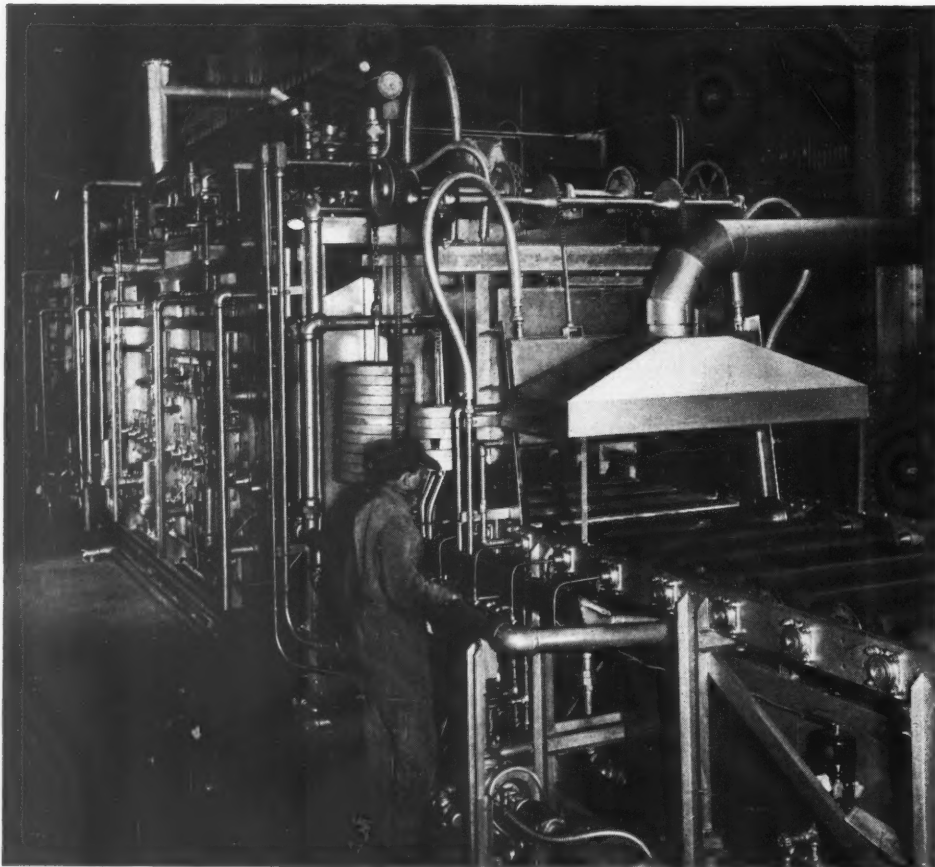
to reduce friction. In certain applications, it is cut into short lengths and placed in a packing box around a shaft. When the cross-sectional diameter of the strand is small enough, it may be wound around a shaft to fill the gland box. This type of packing, although useful for many applications, ordinarily develops considerable friction, and should be used only where low pressures are encountered.

Stacks of circular leather washers are often substituted for hemp in low-pressure applications or where the hydraulic fluid is dirty. They develop less friction than hemp or flax coils and provide better sealing life. When these washers are used for higher pressure applications, they should have beveled peripheries, as shown in Fig. 2, where it can be seen that the wedging action produced by this form forces the packing against the surfaces to be sealed when the gland is tightened. In addition, the entrapped oil resulting from this action acts as a lubricant, and each ring becomes an individual seal.

Circular washers that are to be used in confined grooves may be made from sheet stock—leather, fiber, soft annealed metal, etc. Sheet rubber is not generally recommended for packing in hydraulic systems because it expands under pressure, is not heat-resistant, may be destroyed by some hydraulic fluids, and has a tendency to get soft.

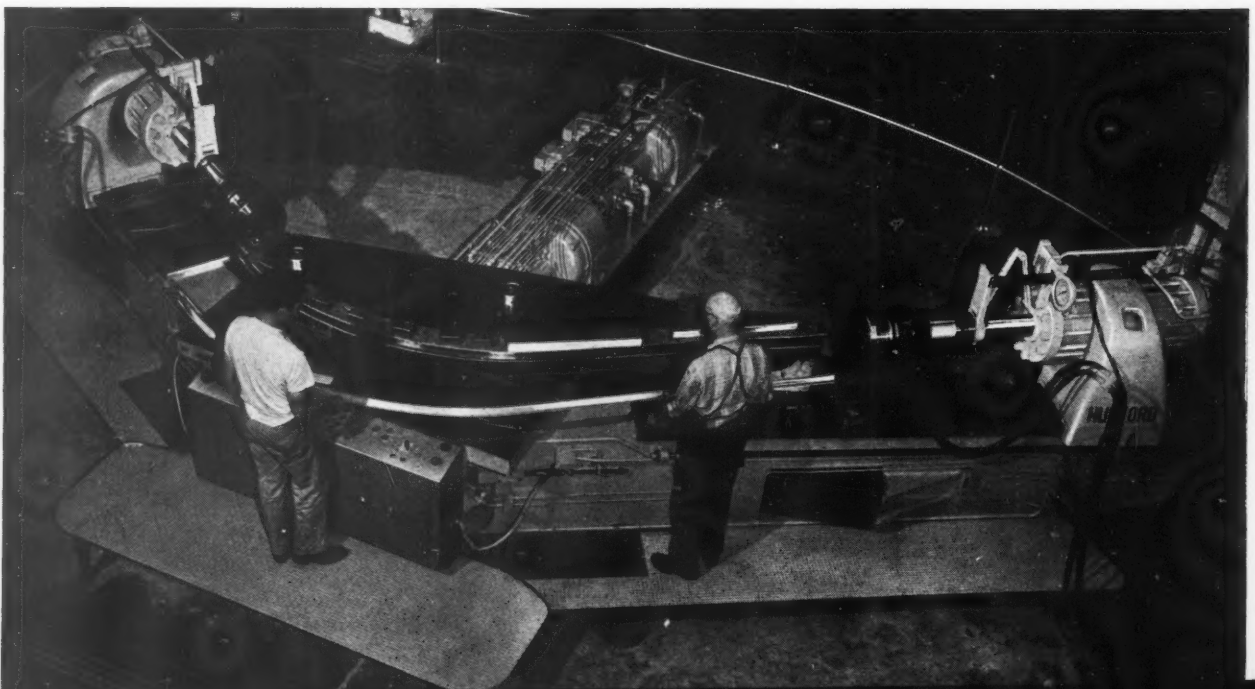
A second article on the subject of packings for hydraulic equipment will further describe packing materials, methods of preparing packings for installation, and various problems encountered in their use, together with the steps required to overcome them.

# In Shops Around the



A continuous carbon-correction, annealing furnace installed at the Massillon, Ohio, plant of the Union Drawn Steel Division of Republic Steel Corporation. In one continuous operation, it both anneals steel bars and restores to their surfaces carbon burned out by previous hot-working operations. A carbon atmosphere prevents further decarburization and corrects existing decarburization. The furnace was built by the Surface Combustion Corporation to specifications drawn up by J. D. Armour, chief metallurgist of the Union Drawn Steel Division

Large Hufford 60-ton stretch-wrap forming machine—part of a \$1,000,000 order of new equipment—now in operation at the San Diego Division of the Consolidated Vultee Aircraft Corporation. Operators are removing an aluminum part which has been stretched into shape



# Country

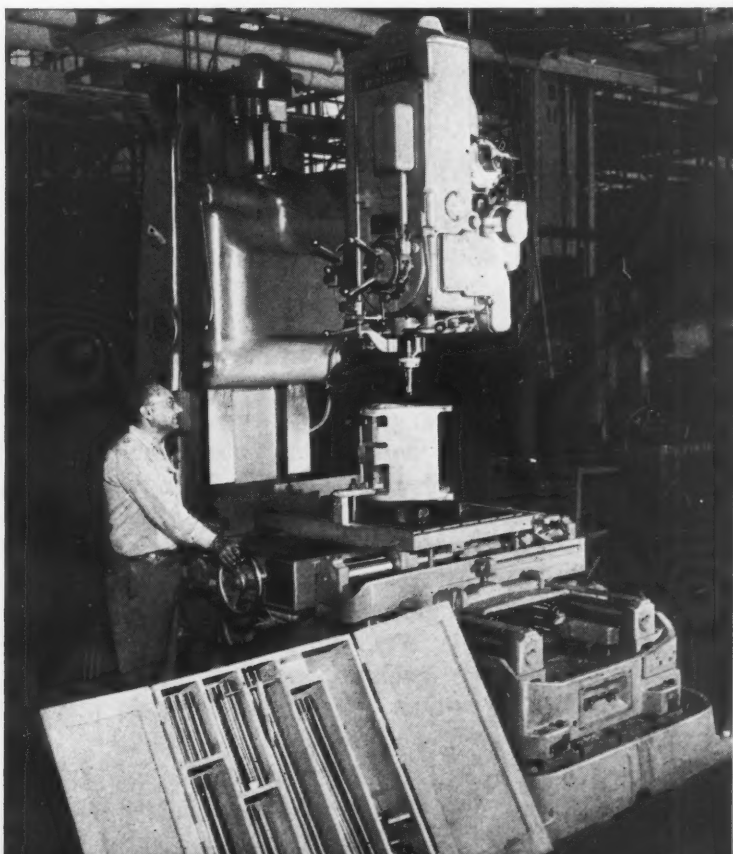
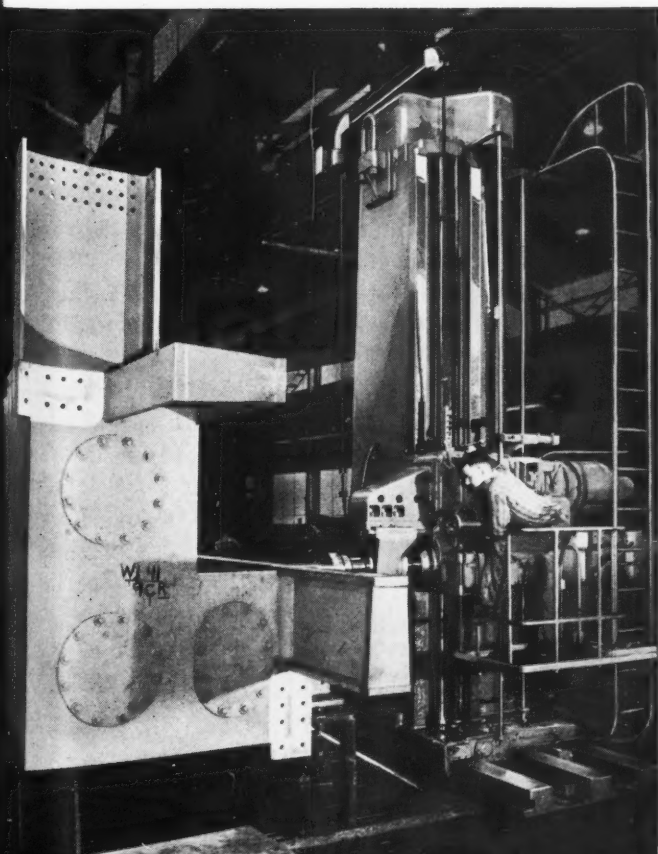
Camera Highlights of Interesting Operations in Some of the Nation's Outstanding Metal-Working Plants



An improved method for testing the critical lubrication requirements of high-speed precision gears has been developed by the Engineering Department of the Texas Co.'s, Beacon, N. Y., laboratories. The new test rig is based on a machine originally designed by Pratt & Whitney Aircraft for bench testing gears and lubricants. The Texaco modification permits speeds up to 16,000 R.P.M. under loads up to 5000 H.P.

A workman at the Pittsburgh plant of the Dravo Corporation performs a delicate milling operation on a section of a testing machine. The work is being done on a new Giddings & Lewis high-power, precision horizontal boring, drilling, and milling machine, equipped with telescoping platform and telescopic vernier sight

Cincinnati-Bickford precision drilling machine with a hydraulically movable table, now in operation at Convair's San Diego Division. The Bullard four-way movable table or spacer is comparable to a jig borer in accuracy and type of work accomplished, but the work is done without the use of costly jigs



# Unique Features of Huge G & L

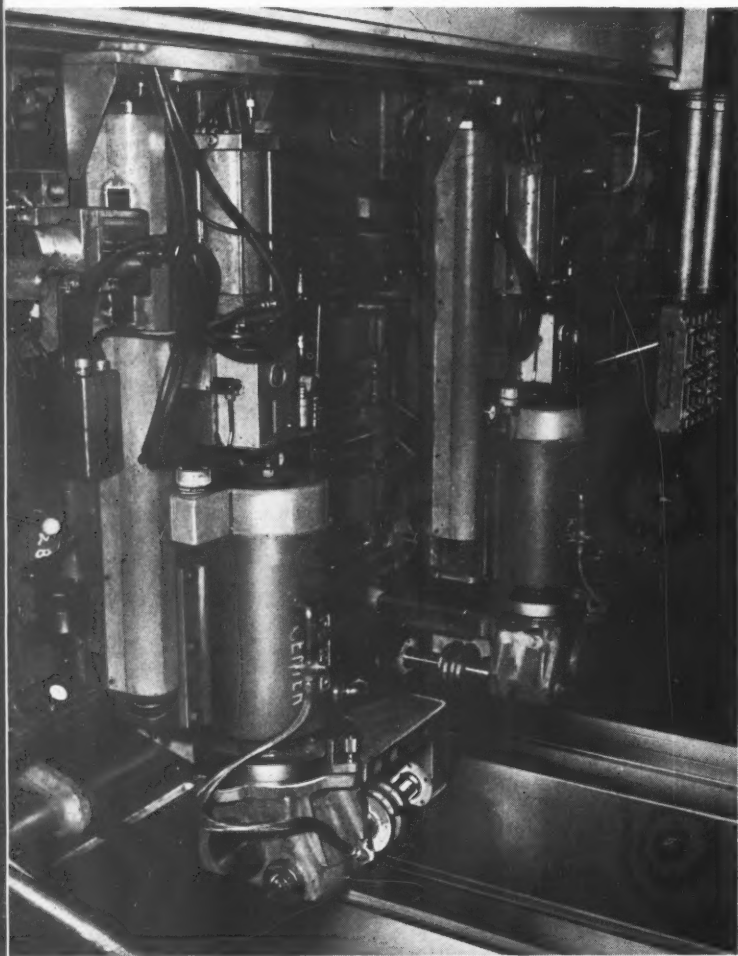


Fig. 1. Motors of 100 H.P. rating supply the power to each milling head of the Giddings & Lewis Hypro special aircraft skin miller

ONE of the most important developments in airplane construction during recent years has been the adoption of wing skins having integral stiffening ribs, in place of the skins of former years which had reinforcing components that were generally assembled by riveting. The skins with milled ribs are lighter in weight and are better able to withstand the great stresses that occur during high-speed flight.

The machining of the integral rib skins necessitated a new manufacturing technique. Several types of machine tools are used for the purpose, but none of them had the capacity or flexibility required by the present program of the Lockheed Aircraft Corporation. To meet these needs, the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., built the Type 100 aircraft skin milling machine described on page 222 of July MACHINERY. The present article will deal

with some of the more unusual features of the machine, which cost \$400,000.

Specifically, the skin miller resembles a planer type milling machine, but conventional features have either been modified or completely redesigned to provide the flexibility needed in aircraft manufacture. It will mill taper panels, as well as integrally ribbed panels having surfaces or webs that vary in thickness. Panels of the latter type are machined through the use of a vertical rise and fall attachment, which is hydraulically operated and controlled. The machine is also equipped with a 360-degree profiling system for operating in a horizontal plane, which embodies the General Electric electronic tracer control.

There are ten primary construction features:

1. A table with a working area 10 feet wide by 34 feet long and capable of handling loads of 150 tons.

2. Two 100-H.P. motor-driven heads which drive either face-mills or gangs of slotting cutters. The gang cutters are from 8 to 10 inches in diameter by 12 inches long, and there is sufficient clearance over the 8-inch cutters to provide for milling slots 1 1/2 inches deep. Spindle speeds range from 1200 to 3600 R.P.M. with stepless adjustment.

3. A third 100-H.P. motor-driven head which is universally mounted so as to swivel 15 degrees in either direction from the vertical. The spindle speed range of this head is from 2400 to 7200 R.P.M.

4. An individual vertical profiling control for two heads, which will carry slotting cutters through 4 inches of vertical movement and machine the work within plus or minus 0.002 inch.

5. An automatic synchronized control for the head and table movements to provide 360-degree profiling in a horizontal plane.

6. Provision for milling angular paths in any direction over the work area without the use of a template.

7. Feed rates for the heads and table from 1 inch to 150 inches a minute with stepless adjustment.

8. A precision measuring system for setting cutters in two planes.

9. A belt type conveyor for picking up chips as they are produced and carrying them to the outside of the building in which the machine is installed.

10. Stainless steel covers for protecting the bed ways.

# Aircraft Skin Milling Machine

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The bed, table, and drive units of the new skin milling machine have a capacity for handling work loads as great as 1000 pounds per square foot on the table, with minimum backlash and deflection. The mechanism is designed to traverse work loads up to 300,000 pounds at a speed of 6 feet per minute for climb and contour milling. The table is mounted on a single vee and double flat ways, which are fitted with a non-metallic bearing material to prevent scoring. The stainless-steel way covers are fastened to both ends of the table, carried over two rollers on each end of the bed, and pass through slots which extend the full length of the bed on the underside. The covers not only prevent chip damage of the bed ways, but also excessive contamination of the way lubricant.

To permit the extremely high spindle speeds needed for this machine, the milling heads are so constructed that the cutters can be mounted directly on the end of the motor shaft. A motor was especially developed for this service through the combined efforts of Giddings & Lewis, General Electric, and Onsrud engineers. The motors are water-cooled and fitted into frames 14 inches in diameter by 32 inches long, as seen in Fig. 1.

A unique dual-slide mounting carries the right-hand and center milling heads. Each head is provided with a front slide that permits 12 inches of vertical travel for positioning the cutters with respect to the work. A rear or rise and fall slide provides 4 inches of vertical movement of the milling heads by

means of a hydraulic cylinder that is controlled through a tracer valve. To obtain power movement of the front slide, it is necessary to "come through" the rear slide, power being taken from the rail shafts.

This arrangement is necessary due to the location of the cams used in profiling, which are positioned above the machine rail, and also because of the location of the tracer valve, which is mounted on the rear slide. The construction

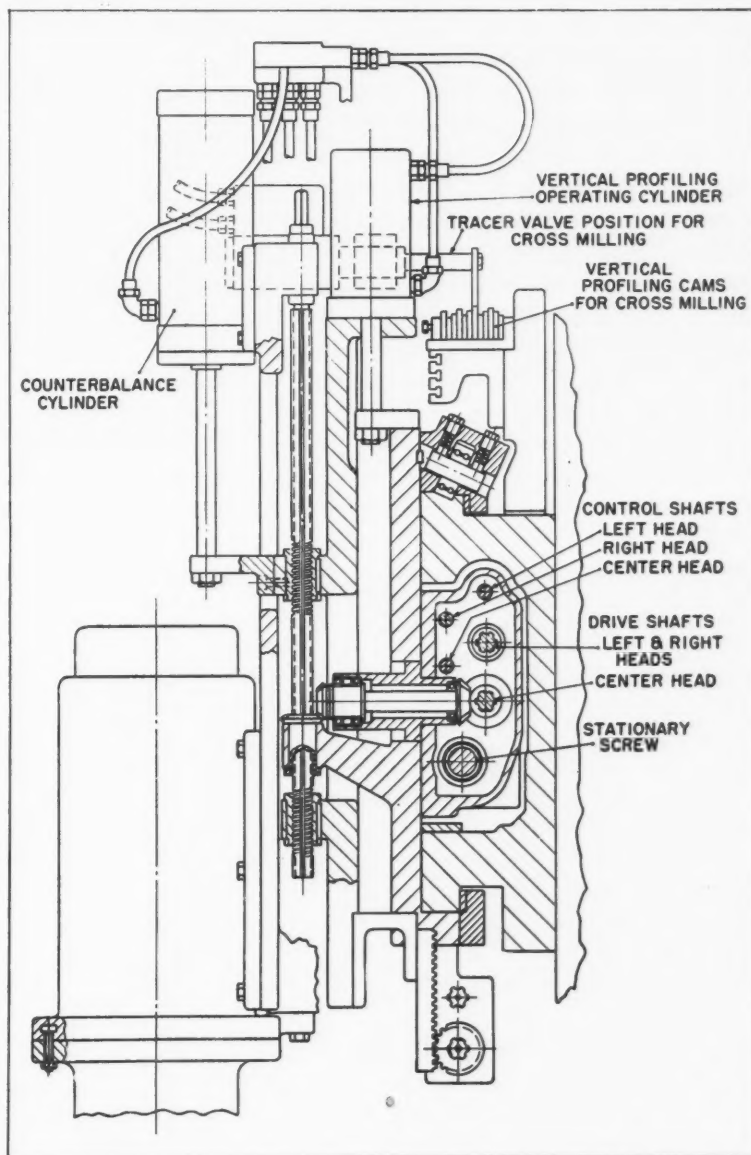


Fig. 2. The power take-off from the rail shafts for operating the front slides of the milling heads is illustrated in this drawing, there being a simplified arrangement of a single drive-shaft to the rail-heads

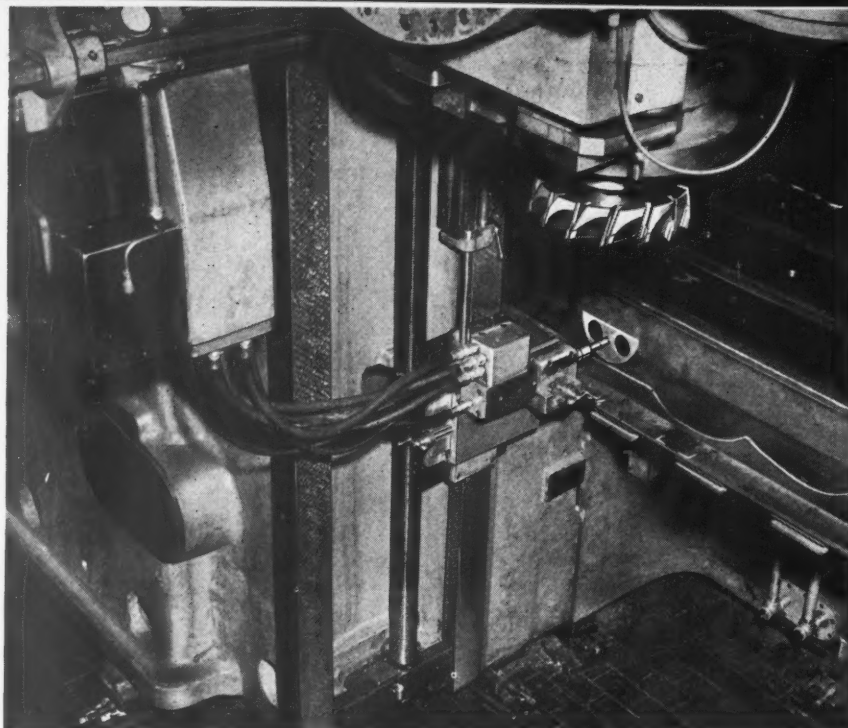


Fig. 3. The tracer control valve is mounted on the rise and fall slide adjacent to the table and can be quickly removed by taking off a valve plate. The hydraulic hose connections remain intact as the plate is moved from one position to another

is illustrated by the schematic drawing, Fig. 2. In order that the cutter position be accurately maintained, the front slide is slightly over-counterbalanced by an air cylinder.

Horizontal spindle attachments are supplied for the center and right-hand heads, as seen in Fig. 1. These units are attached to the end of the motor frame and will swivel 90 degrees, so that it is possible for the cutters to mill either parallel or at right-hand angles to the direction of table travel. In milling crosswise of the machine, one head follows the other, the front head carrying roughing cutters and the rear head finishing cutters. This arrangement demanded considerable design ingenuity in order that the spindle center distances be held to a minimum. The cutter-arbors of the two heads may be as close as 10 inches during cross-milling opera-

tions. When milling parallel to the table and using the table feed, the spindle attachments are swiveled to bring the arbor ends as closely together as possible.

A hydraulic circuit is used to activate the center and right-hand rail-heads in tracer-controlled operation. The rise and fall movement of each head is initiated by a stylus wheel which follows the contour of a single master cam or a number of cams. The location of the cam or cam assembly is above the rail in cross-milling, or on a bracket bolted to the side of the machine table in lengthwise milling.

The latter arrangement presented a design problem, because the stylus and tracer valve that operate in conjunction with the table cams are 12 feet away from the rise and fall slide that carries the cutters. To insure nearly simultan-

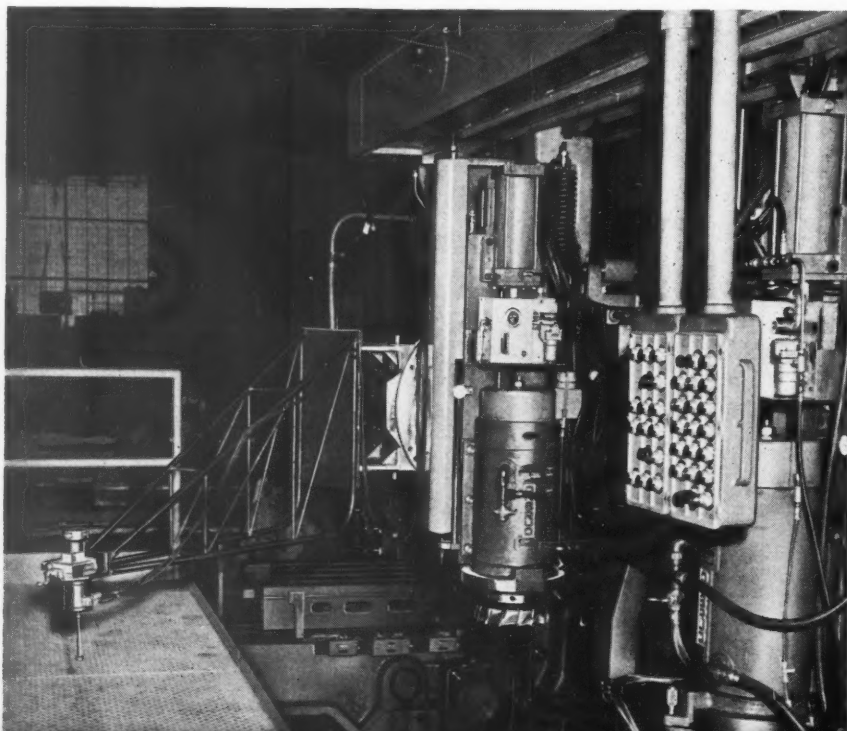
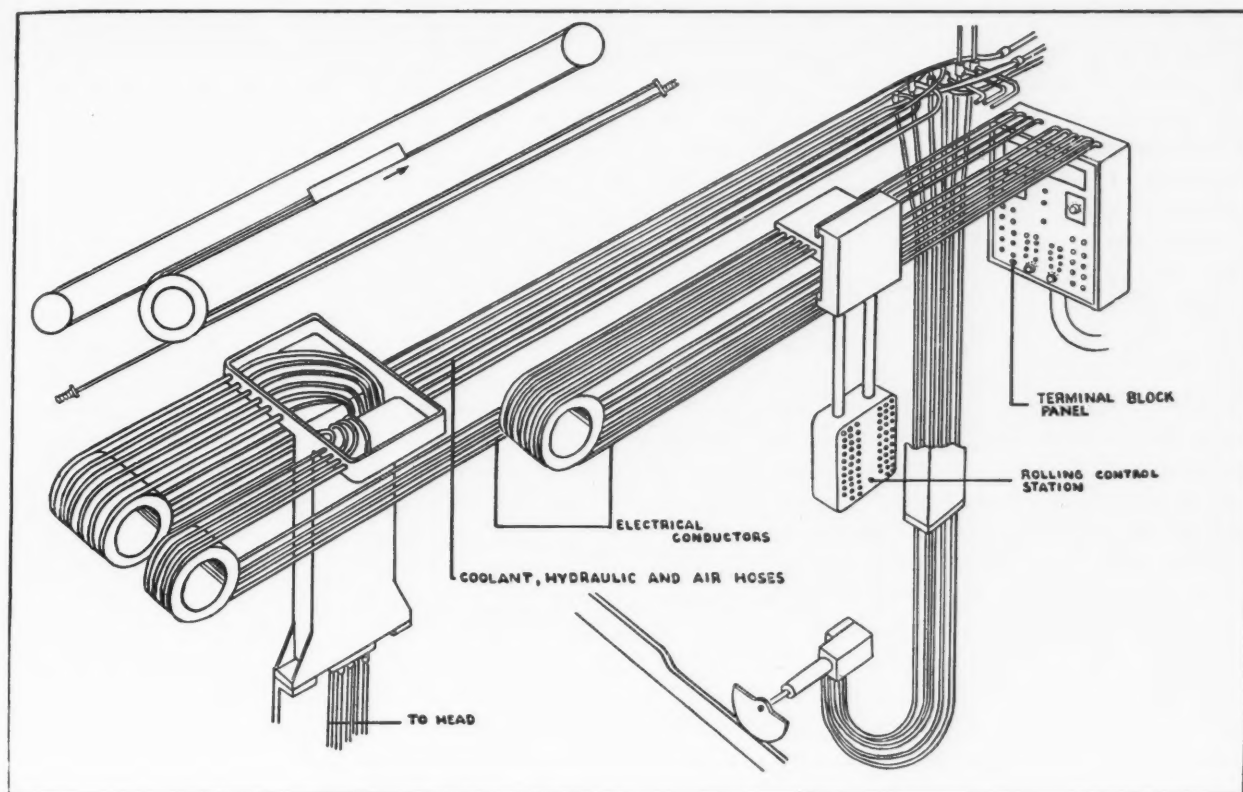


Fig. 4. Method of mounting the electric tracer control arm and stylus for the profile milling head permits profiling over the entire working area of the table



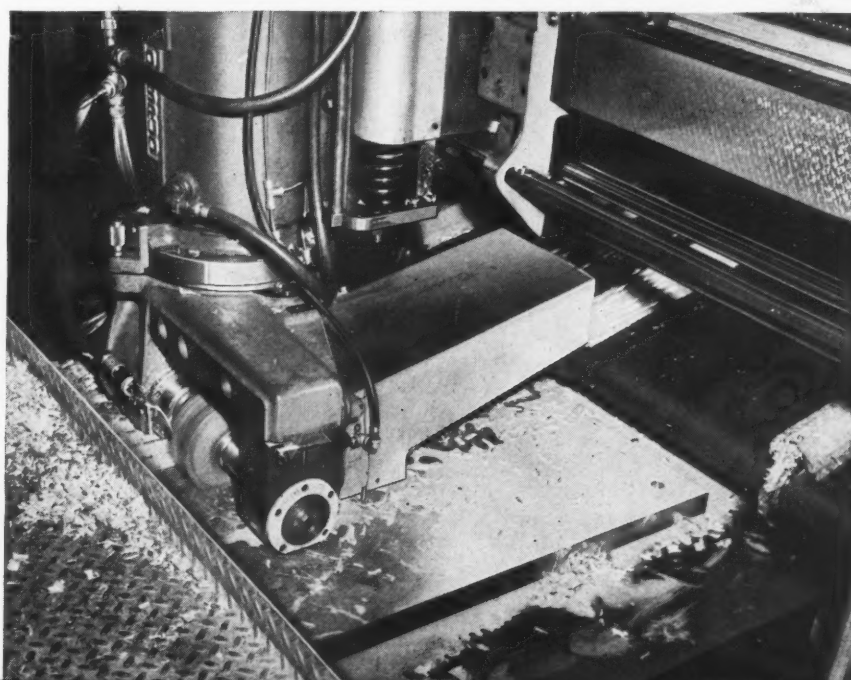
**Fig. 5.** The maze of cable, wire, and hose required for each milling head is systematically handled by a feed reel mechanism shown here diagrammatically

eous motion between the cutters and the tracer valve, the latter is mounted on a ball-bearing slide which is connected to the rise and fall slide through splined shafts and a rack and pinion construction.

Only two of the three rail-heads can be operated simultaneously. The left-hand head is used primarily for face- and profile-milling, and this head swivels 15 degrees front to back and 15 degrees to the right or left of vertical. This is the head that may be run at speeds from 2400 to 7200 R.P.M. It is used basically for milling

irregular cut-outs. A swiveling arm mounted on this head, as shown in Fig. 4, carries the electric tracing head used in profiling in a horizontal plane.

The left-hand milling head is constructed similarly to the center and right-hand heads, but it is controlled electrically rather than hydraulically. Vertical movements of all heads are controlled from a rolling push-button station that is mounted above the rail and suspended at a height convenient to the operator, as may be seen by referring to Fig. 4.



**Fig. 6.** High-tensile aluminum chips, which are produced as fast as 600 cubic inches per minute, are deflected to a multiple-belt conveyor that extends across complete width of machine between housings

One of the most difficult problems to solve in designing this machine was to provide a practical method of handling the maze of hose, conduit, and cable, and to guard against interference of these leads in the operation of the milling heads. All together, there are six hose lines to each head—a hydraulic pressure and return line, a scavenger line, two water lines, and an air line. In addition, there are approximately twenty electrical conductors.

To handle these water, electrical, and air lines, a feed reel was designed, which is a completely covered beam-like unit located immediately above the machine rail. This unit contains seven horizontal ducts, each of which is provided with a multiple-roller and take-up system, as seen in Fig. 5. Separate compartments are assigned to the hose and the electrical conductors of each head. The seventh compartment accommodates the rolling push-button station, which is mounted on tracks attached to the reel supporting structure. Slack in any hose or electrical lead is taken up instantly as the milling heads travel to the right or left and up or down.

The machine is designed to handle rolled aluminum plate up to 1 1/2 inches thick. When using a gang of slotting cutters, as shown in

Fig. 6, chips are produced at rates as high as 600 cubic inches of high-tensile aluminum per minute. Obviously, chip removal becomes a serious consideration. The cutter-heads are equipped with deflectors, as seen in the illustration, which throw the newly formed chips on a multiple-belt conveyor. This conveyor extends across the complete width of the machine between the housings. The belts move parallel to the table and at a slight upward angle to a cross-belt seen in Fig. 7, which carries the chips from the machine. When the skin miller is installed in the Lockheed plant, a third conveyor will carry the chips to a truck or storage receptacle located outside the building.

The Hypro electronic drive for the table feed and traverse operates through twin racks bolted to the under side of the table and twin helical gears that mesh with these racks, as shown in Fig. 8. Between these gears, and mounted on the same shaft, is a bronze Cone-drive worm-gear of somewhat larger diameter than the helical gears. The driving worm is mounted below the worm-gear in preloaded ball bearings to eliminate axial deflection. A magnetic multiple-disc brake provides a positive table lock in cross-milling operations.

Because of the massive dimensions of this machine, it was especially desirable to insure easy operation, and so provision has been made for complete push-button control of all essential functions from conveniently located stations. A fixed station, suspended from the right-hand end of the rail, is used primarily in setting up. This station contains indicating instruments, push-buttons, selector switches, and speed control rheostats. The rolling station contains push-buttons and rheostats for direct control during operation.

In addition to the milling head and feed drives already described, there are a number of auxiliary drives, such as a 15-H.P. rail elevating motor; a 3-H.P. motor for the chip disposal conveyor; a 2-H.P. coolant pump motor; a fractional-horsepower motor for coolant filter; a 3-H.P. motor for hydraulic rise and fall tracer system; and a 1 1/2-H.P. lubrication pump motor.



Fig. 7. End of multiple-belt conveyor from which the aluminum chips drop on a cross belt that carries them away from the machine

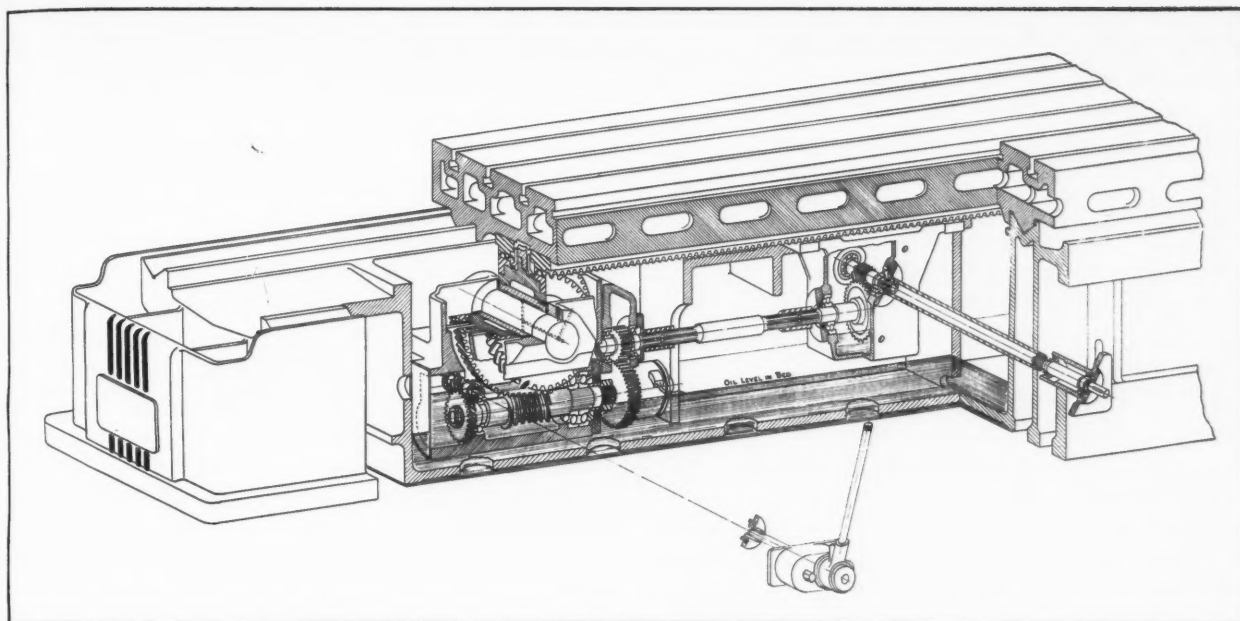


Fig. 8. Cut-away view which shows the arrangement of the twin helical-gear and Cone worm drive to the table of the huge airplane skin milling machine

Squirrel-cage induction motors are seldom considered for adjustable-speed drives, but they were adopted for this machine because of such design requirements as size and weight, and also because induction motors can be run at high speeds with good dynamic balance. To obtain the required speed ranges, these head motors are supplied with adjustable frequency power from alternator sets which are driven by direct-current adjustable-speed motors. Fig. 9 shows in simplified form the arrangement of the electrical equipment supplied for the milling spindle drives. There are two power supplies for the three heads, so that any two heads can be run simultaneously. Double-throw reversing switches enable milling cutters to be run either clockwise or counter-clockwise.

Each power supply consists of two two-unit motor generator sets. The alternating-current direct-current set has a 200-H.P. induction motor which drives a 125-kilowatt adjustable-voltage generator at a constant speed of 1800 R.P.M. The direct-current alternating-current set consists of a 150-H.P. direct-current motor driving a 100-kilo-

watt three-phase alternator. The alternator may be driven at any speed between 600 and 1800 R.P.M. to give a range of output frequencies from 40 to 120 cycles. This frequency range, in conjunction with the four-pole motors in the

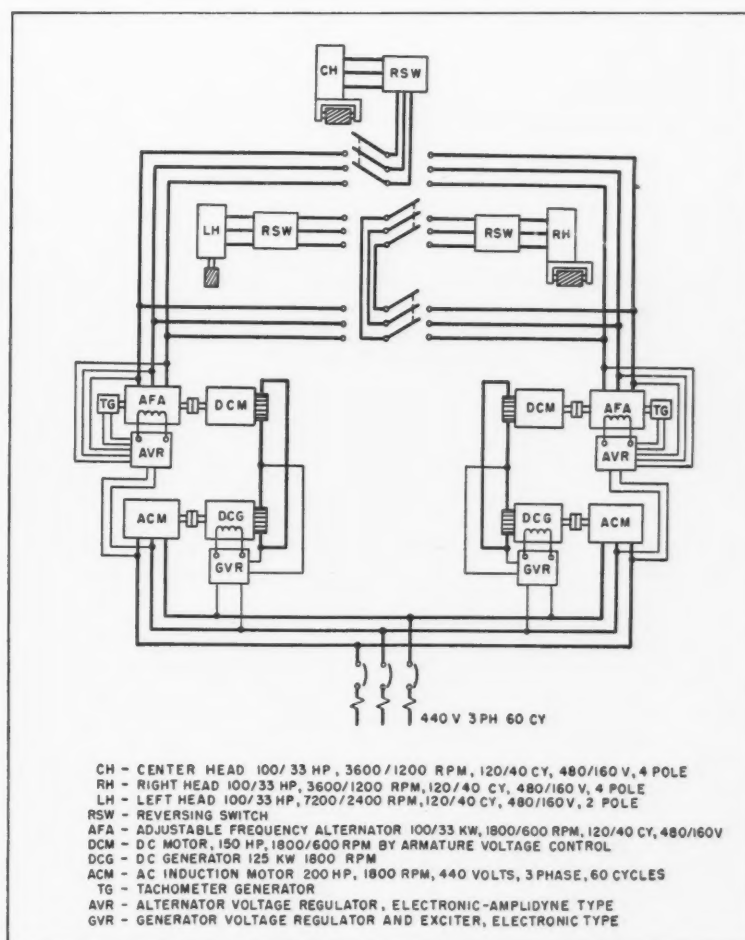


Fig. 9. Diagram showing the arrangement of the power supply and control system for the adjustable-speed milling heads

right and center heads, gives the speed range of 1200 to 3600 R.P.M., and, in conjunction with the two-pole motor in the left-hand head, the speed range of 2400 to 7200 R.P.M.

The speed, and hence the frequency, of the alternator is controlled by means of the shunt field excitation of the 125-kilowatt direct-current generator. A phase-controlled thyatron rectifier supplying the generator field permits the machine operator to control the speed of the milling head from a small rheostat in the operator's station.

A load compensation control on the direct-current adjustable-voltage drive automatically boosts the direct-current generator voltage with increased loads on the head motors, so as to insure that the motor speed remains constant as the cutter load changes. A tachometer indicator on the alternator set shows the speed of a milling head directly in revolutions per minute.

Electronic - amplidyne regulators supplying field excitation to the alternating-current alternators regulate the alternator voltage. When the alternator speed is changed to cover the frequency range of 40 to 120 cycles, the alternator voltage automatically provides a range of 160 to 480 volts. Thus the operator has finger-tip control of head speeds, with an automatic electronic control of both the voltage and frequency of the milling head motors.

Each of the table and head feed motors receives adjustable-voltage direct-current power from its individual amplidyne generator on a

motor-generator set. The machine operator has finger-tip control of the feed drives at all times from small speed-control potentiometers and push-buttons conveniently located on the rolling control station. There are three different types of operation available for the feed drives—an individual feed control, an angle milling or steering control, and the 360-degree tracer control.

In addition to a maintained feed in either the forward or reverse direction, jog and traverse operation are available at fixed speeds through push-button control. In angle milling, the two feed drives are controlled simultaneously through a single set of controls, there being two dials—one for angle and the other for speed.

With the 360-degree tracer control, the direction and speed of the two feeds are controlled simultaneously by signals in the tracing head, which occur whenever the deflection of the stylus in any direction changes the relationship between air gaps in magnetic circuits. The signals are amplified electronically to control the two feed drives. Once the stylus of the tracing head is brought into contact with the template, the operation of the tracer control system is entirely automatic. The tracer follows completely around a closed path on either an internal or external template without any attention on the part of the operator, and the movement of the tracer may be clockwise or counter-clockwise.

This machine can be built in various sizes and with different features to provide for handling the wide range of skin panels.



Giant hexagonal nuts for a 250-ton hydraulic press are cut to shape by the oxy-acetylene process at the General - American Transportation Co.'s plant in Sharon, Pa. The blow-pipe is mounted on an Oxweld cutting machine, made by the Oxweld Railroad Service Co., a Division of the Union Carbide and Carbon Corporation. Cutting is accomplished at the rate of 3 inches per minute through the 24-inch thick low-carbon steel billet. Previous to the operation shown, a hole was cut out of the center of the block. After cutting to shape, the hexagonal nuts are threaded

# Electrostatic Atomization of Paint Reduces Cost of Metal Finishing

**P**AIN'T is atomized into a fine spray of electrically charged particles, which are instantly drawn to metal parts carried along a conveyor line in a process recently developed by the Ransburg Electro-Coating Corporation, Indianapolis, Ind. With this method, from 200,000 to 300,000 particles of paint leave the spraying head every second. The new process is known as the No. 2 "Electro-Spray Process" to distinguish it from the Ransburg electrostatic spray, in which conventional automatic spray guns are used.

The principle of electrostatic atomization is employed instead of compressed air. The spray gun consists essentially of a Meehanite hollow, cone-shaped head, Fig. 1. The coating material, which flows to the head at a constant rate from a metering pump, is uniformly spread over the inner surface of the head as the result of centrifugal force obtained by rotating the head at high speeds. A strong electrostatic field is set up between the work (which is grounded by the conveyor) and the spray head.

The force of this field transforms the material into a fine spray of charged particles and creates an irresistible attraction that pulls the spray particles to the grounded work. This results in complete electrostatic deposition. Air pressure, spray pattern, fluid delivery, over-spray, exhaust air currents, and other variables usually present in conventional spraying operations are elimin-

ated. Thus, the process removes all dependence on the skill of an operator.

All of the paint leaving the spray head is deposited, and there is no other spray to be exhausted. When the shape of the article or the method of conveying does not permit complete deposition of the paint on a part, a backboard is employed to receive the excess paint. No water-wash walls for the collection or removal of wasted paint are necessary. The ventilation of the area for the control of solvent vapor is all that is required.

Applications of this process in several plants throughout the country have been extremely successful. For example, a unit installed at Interstate Metal Products, Inc., Michigan City, Ind., is used for the spray painting of metal chairs for the government. In comparison with the former hand spray method, this company now paints four times as many chairs per gallon of paint. The production rate by hand spray methods was from 550 to 600 units per day, whereas the rate is now 1300 chairs per day. In this operation, one coat of metallic copper synthetic enamel is applied to the chairs, which are carried on an overhead monorail at a speed of 11 1/2 feet per minute (Fig. 2).

At the Seymour Tool & Engineering Co., Seymour, Ind., metal ironing boards are given one coat of white enamel on both sides by means of

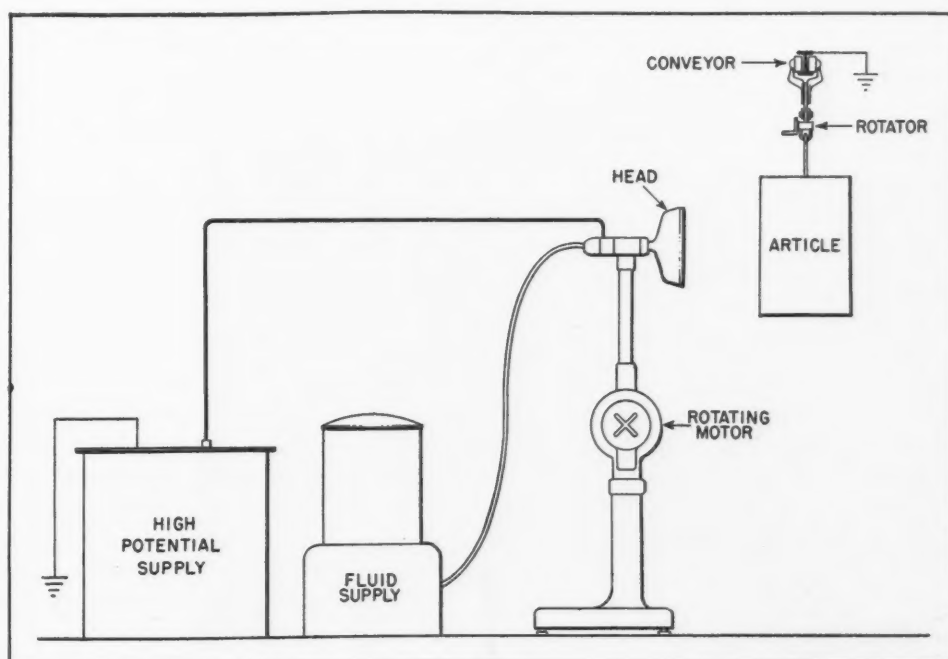


Fig. 1. Diagram of Ransburg "Electro-Spray Process" which employs the principle of electrostatic atomization

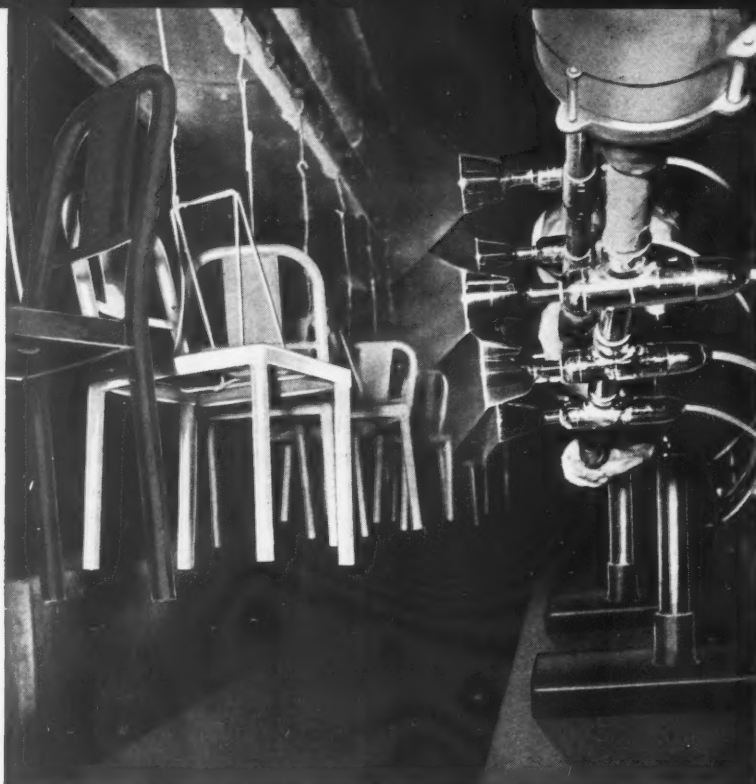


Fig. 2. Metal chairs, carried along a conveyor line, are painted at the rate of 1300 per day by the use of the Electro-Spray Process

the new process. The production rate, compared with the hand spray method, has been doubled, and paint cost reduced 58 per cent per unit.

Other advantages gained in this plant include the training of new labor in approximately twenty minutes, compared with about one month required for adequately training a new hand spray man. In addition, the clean-up time is only five minutes per day, compared to one day per week for the old set-up. The ironing boards,

Fig. 3, are carried on an overhead monorail at a speed of 17 feet per minute.

The newly developed process can be used to coat most parts whose production volume justifies consideration of a conveyORIZED finishing operation. The work may be either metallic—ferrous or non-magnetic—or non-metallic. Any coating material that can be readily atomized can be applied by this method. Enamel, lacquer, and varnishes are handled satisfactorily.

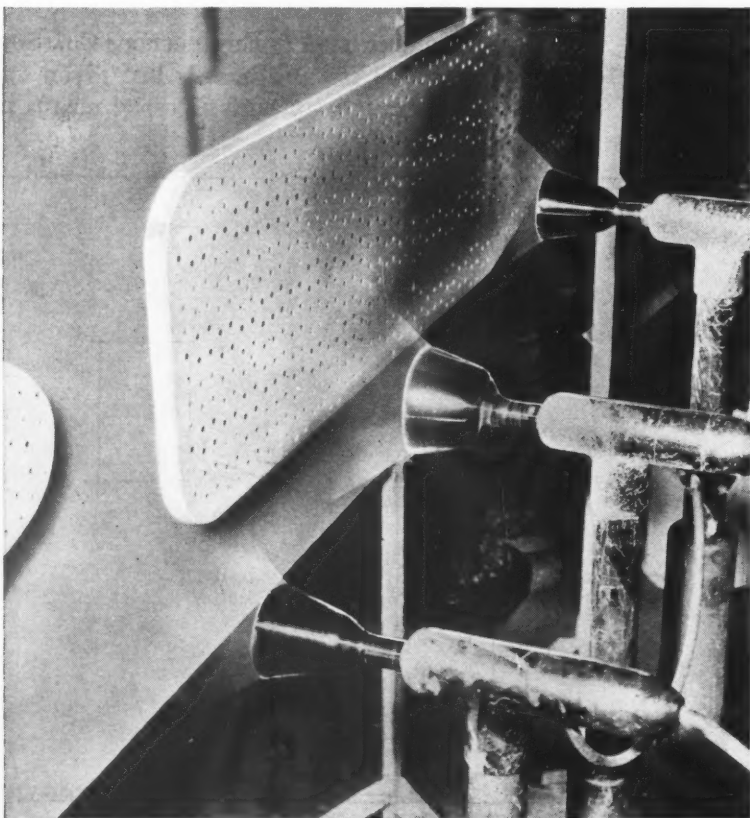


Fig. 3. Production rate in painting these metal ironing boards was doubled, and at the same time, paint cost was reduced 58 per cent by using the new process

# Geometrical Applications that Save Time in Die Design

By FEDERICO STRASSER

**S**KILL in the solution of geometrical problems is of tremendous value in the design and use of tools and dies. Several special applications of geometry, especially useful as time-savers in designing and applying dies, are described in this article.

## Quick Method of Determining Perimeters

One of the first steps in selecting a press for a blanking operation is to calculate the pressure required. This is determined by means of the well-known formula:

$$\text{Pressure required} = \text{Shearing strength} \times \text{Thickness of blank} \times \text{Perimeter of blank}$$

The shearing strength of the material to be cut can be found in a handbook, and the material thickness is easily measured. The perimeter of the blank, however, must be calculated. This can be done quickly in the case of regular geometrical figures, such as circular, square, or rectangular shapes, but is more difficult when the blank contour is irregular.

In cases of irregular contour blanks, much time can be saved in calculating the perimeter by

calculated perimeter is somewhat less than the correct value. The discrepancies in the two latter cases are so slight, however, that they can generally be neglected in the selection of a press for a blanking operation.

## Angular Location of Blanks on a Strip

An important step in die design is the correct location of the blanks in the strip stock. It is often advantageous to position irregular-shaped blanks at an angle with relation to the center line of the strip, as shown in Fig. 2, thus reducing the amount of scrap to a minimum. In such cases, the angle  $A$  can be quickly calculated by means of the formula:

$$\sin A = \frac{\frac{D}{2} + \frac{W}{2} + B}{D + B}$$

where

$D$  = diameter of center of blank;

$W$  = width of blank; and

$B$  = "bridge," or minimum distance between two adjacent blank openings.

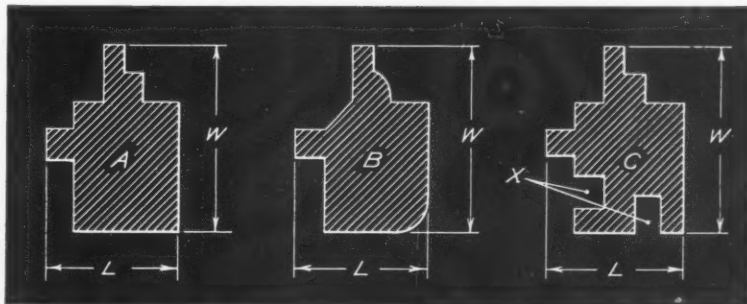


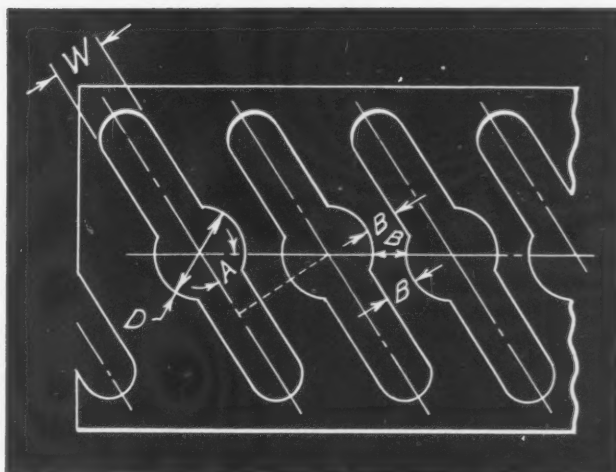
Fig. 1. (Left) Time can be saved in determining the perimeters of blanks by multiplying the sum of maximum length and width by 2

simply multiplying the sum of the maximum length and width of the blank by 2. For irregular shaped blanks such as illustrated in Fig. 1, the formula would be:

$$\text{Perimeter} = 2(L + W)$$

This method is absolutely correct when all segments of the blank periphery form exact right angles and there are not any recesses in the blank, as is the case with blank A. However, when the blank edges form diagonal lines or curves, as seen at B, the perimeter obtained by this method of calculation is slightly larger than the correct value. Also, when the blank contains recesses such as those seen at X on blank C, the

Fig. 2. (Below) Diagram used in calculating angle (A) at which the blanks are inclined with relation to the center line of the strip stock



### Determining the Cutting Center of Dies

In order to equalize the forces exerted during blanking, the axis of the punch-holder shank should coincide with the so-called "cutting center" of the die. This center is established in the same way that the center of gravity of geometrical figures is determined, as illustrated in Fig. 3.

In the example seen at the upper left, which is a single blanking or piercing die with only one punch, the cutting center  $C$  corresponds to the geometrical center of the blank. In the case of square or rectangular-shaped blanks, the center  $C$  lies at the intersection of the two diagonal lines joining the corners of the blank. In a duplex die with two punches of the same shape and size, as seen at the upper right, the cutting center  $C$  lies midway between the geometric centers  $C_1$  and  $C_2$  of the two blanks or punches.

When two unequal sized punches are used in a duplex die (lower left), the perimeters of the blanks (which are proportional to the required pressures when the same material and thickness are being blanked by both punches) must first be determined. The cutting center  $C$  lies on a straight line connecting the geometric centers  $C_1$  and  $C_2$  of the two blanks or punches. The distance of the cutting center from either geometric center is inversely proportional to the perimeters of the blanks, or:

$$\frac{L_1}{L_2} = \frac{P_2}{P_1}$$

where  $L_1$  and  $L_2$  are the respective distances of the cutting center from the geometric centers  $C_1$  and  $C_2$ , and  $P_2$  and  $P_1$  represent the respec-

tive perimeters of the smaller and larger sized blanks.

When more than two punches, of either equal or unequal size, are included in a die (lower right), the cutting center  $C$  lies on a straight line connecting the intermediate cutting center  $C_{1+2}$  and the geometric center of the third punch  $C_3$ . The proportions of distances to perimeters are given on the drawing.

\* \* \*

### Greater Use of Handicapped Planned in Defense Work

A special Task Force has been designated to develop plans for the more effective training, placement, and utilization of handicapped persons in the defense program, Mobilization Director Charles E. Wilson has announced. Formed on a decision of the National Manpower Policy Committee, the new Task Force will survey existing services and practices and make recommendations on steps for better utilizing handicapped persons.

The Task Force is composed of nationally prominent citizens, familiar with various phases of the handicapped persons' employment situation. The chairman is Dr. Theodore G. Klumpp, president of Winthrop-Stearns, Inc., New York.

\* \* \*

The American steel industry is now pouring three tons of steel for every ton poured in Russia and her satellite countries. It has a capacity of more than 100,000,000 tons—5,000,000 tons more than in 1945 at the end of the war.

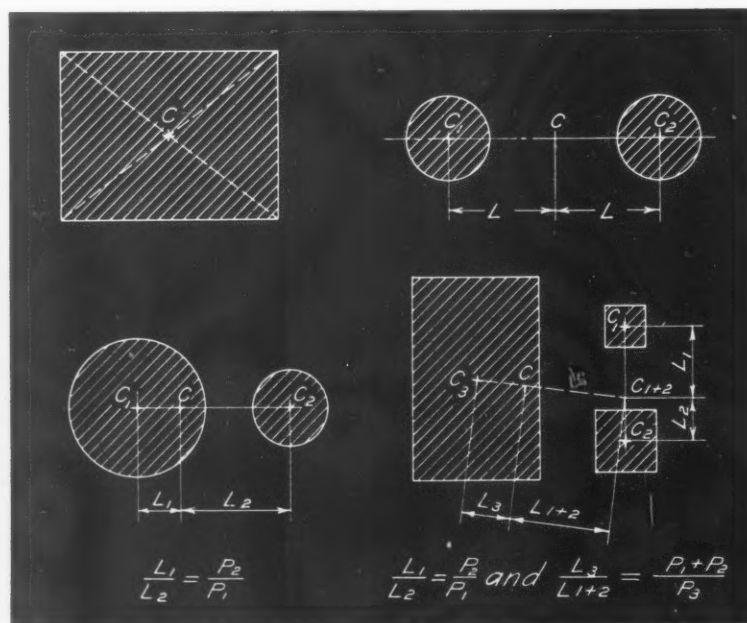


Fig. 3. Methods of determining the cutting center ( $C$ ) for single, duplex, and multiple dies. The distances ( $L$ ) are inversely proportional to the blank perimeters ( $P$ )

# TOOL ENGINEERING

# Ideas

Tools and Fixtures of Unusual Design and Time- and Labor-Saving Methods that Have been Found Useful by Men Engaged in Tool Design and Shop Work

## Multiple Drill Jig with Indexing V-Blocks

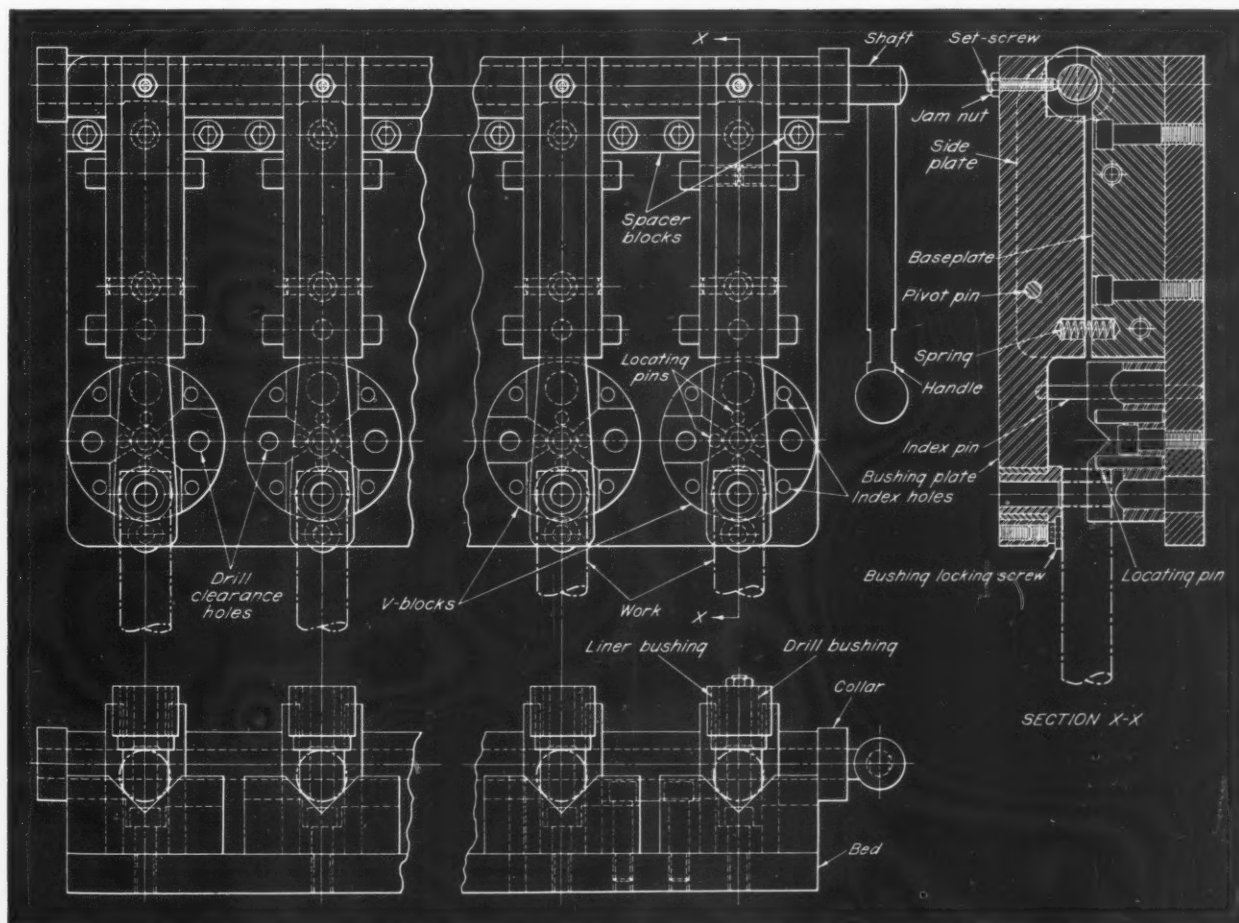
By ROBERT MAWSON

A novel feature of the multiple drill jig seen in the accompanying illustration is the use of indexing V-blocks to locate work-pieces of various sizes. Each of the six cylindrical V-blocks has four vee surfaces for holding work-pieces 3/4, 7/8, 1, or 1 1/4 inches in diameter.

The jig was designed for drilling cross-holes near the ends of adjusting screws. Since the

diameter of the cross-holes and their distance from the ends of the screws vary on different diameter screws, this jig obviates the need of individual tools for each size screw. Six screws of the same or various sizes can be drilled simultaneously, thus reducing the manufacturing cost per unit and also the lost or non-productive time required to locate and remove the parts.

A shaft passes through holes reamed in the seven spacer blocks that are secured to the bed of the jig. Collars are provided on the ends of the shaft, and a handle is mounted on the right-hand end for operating the jig. Attached to the



Multiple drill jig equipped with V-blocks, each having four vee surfaces, which can be indexed to accommodate work-pieces of various diameters. The bushing plates are pivoted for loading and drilling by lowering and raising the handle, respectively

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bed, between the spacer blocks, are six baseplates, and secured to the sides of each baseplate are a right- and a left-hand side plate. These side plates are freely mounted on the shaft.

Suspended from a pivot-pin between each pair of side plates is a bushing plate. An oval-point socket-head set-screw is screwed through each of the six bushing plates, directly above the center of the shaft. The set-screws are held in vertical adjustment by means of jam nuts. Springs, held in pockets machined in the upper and lower surfaces of the baseplates and bushing plates, respectively, keep the oval points of the set-screws in contact with cam surfaces on the shaft. When the shaft is rotated by lifting the handle, the bushing plates are pivoted about their respective pins.

Driven into the forward end of each bushing plate is a liner bushing. Various drill bushings can be slipped into the liner bushings for drilling different sized screws. A locking screw, threaded into the under side of the bushing plate, holds each drill bushing in place.

The V-blocks, which are held to the base of the jig by means of hexagon, socket type cap-screws, are located radially, to align the proper vee surface with the particular size screw to be drilled, by index-pins. Each of these knurled-head pins passes through one of the four index-holes in the V-block and into a hole in the base of the jig. Four clearance holes are also provided in each V-block to allow the drill to break through the work-piece. Finally, four locating pins are driven into predetermined radial positions in the V-block, so that when the work-piece is abutted against one of the pins, the hole is drilled in the desired endwise location.

In operation, the spacing of the spindles on a Natco multiple-spindle drilling machine is adjusted to the center distances between the drill bushings on the jig. With the V-blocks indexed to their correct position, the handle on the jig is depressed. This allows the springs to pivot the bushing plates, lifting their forward ends so that the work-pieces can be placed on the vee surfaces.

The outer ends of the adjusting screws to be drilled rest on a separate block (not shown) of the correct height. When the handle is lifted, the cam surfaces on the shaft pivot the bushing plates in the opposite direction, thus bringing the drill bushings into contact with the work-pieces. Holes can then be drilled in all six parts simultaneously.

## Faceplate Chuck Designed for Two Operations on Similar Parts

By ROBERT W. NEWTON, Tool Engineer  
International Business Machines Corporation  
Poughkeepsie, N. Y.

Savings in tool costs, as well as in set-up time, are often possible by designing chucks, jigs, and fixtures to accommodate several similar parts. In many cases, still further savings can be made by making provisions on such equipment to permit relocation of the work so that two or more operations can be performed on the same piece in one chuck, jig, or fixture. Advantage was taken of such means for reducing costs in designing the faceplate chuck shown in Fig. 2 for use in performing two different operations on the two parts shown at A and B in Fig. 1.

The two similar pieces illustrated are cut-off valve bushings for air-brake control valves. Bushing A is required to have the bore C finish-bored to a diameter of 1.375 inches and the bore D to a diameter of 1.500 inch. It is also necessary to have the bore E, at the opposite end of the piece, finish-bored to a diameter of 1.6875 inches and to finish-form the seat at X.

In the case of bushing B, it is necessary to finish-bore the 1.375-inch diameter and the 1.872-inch diameter holes. At the other end of this piece it is required to finish-bore the 1.685-inch diameter hole and to finish-form the seat at Y.

Since the outside dimensions of these two work-pieces are almost identical, it was possible to design the simple faceplate chuck (Fig. 2) to machine the 1.375-inch and the 1.500-inch holes in one piece and the 1.375-inch and the 1.872-inch holes in the other piece. Both work-pieces are located in the chuck on the 2.495-inch outside

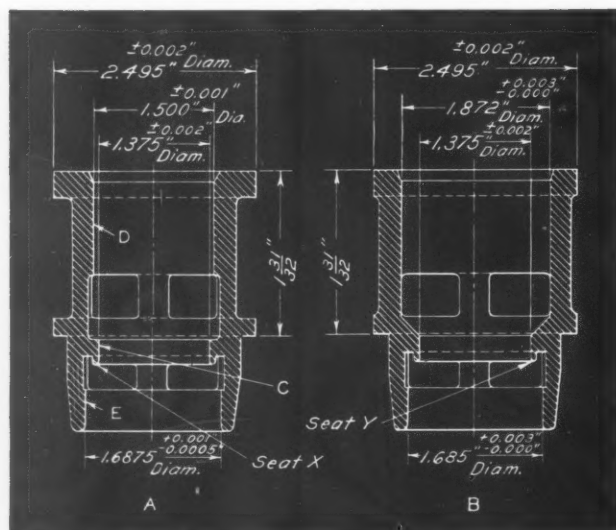
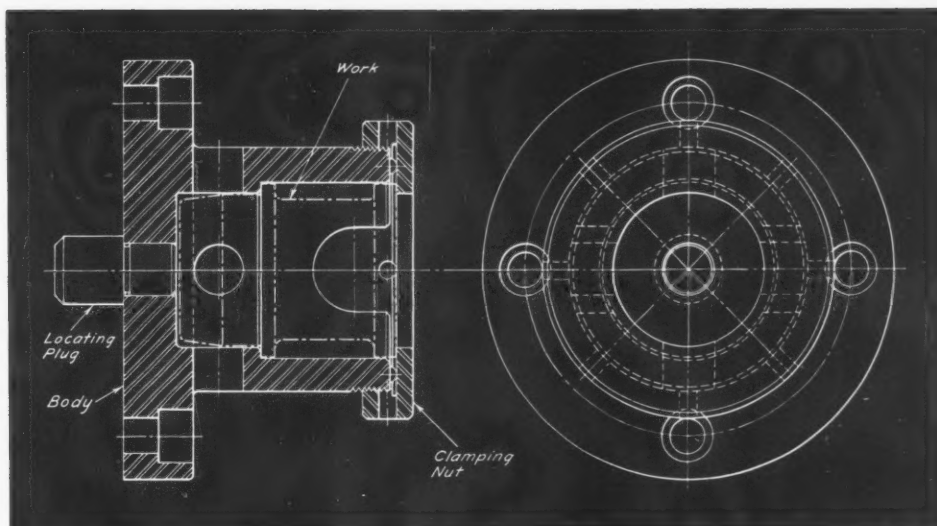


Fig. 1. Valve bushings of similar design requiring boring operations performed by use of the faceplate chuck shown in Fig. 2

Fig. 2. Faceplate chuck designed to hold similar parts (A) and (B), Fig. 1, in two different positions for machining operations



diameter, which is  $1 \frac{31}{32}$  inches long, with a relieved center section. After one end of each work-piece is machined, it is reversed in the chuck, still locating on the 2.495-inch outside diameter. Then the other holes and the seats are machined.

As shown in Fig. 2, the chuck consists of a body, a nut for clamping, and a hardened locating plug. One end of the body is bored to a slip fit for the 2.495-inch diameters on the work-pieces. The depth of this bore is such that this portion of the work-pieces projects from the end of the body about  $\frac{3}{32}$  inch. Another hole is machined in the body of the chuck that is large enough in diameter and deep enough to clear the small ends of the work-pieces when the holes are being finish-bored in the large ends.

To aid in removing chips, four holes are drilled through the chuck body in to the clearance hole. These holes are tangent to the top face of the bolting flange on the body of the chuck. The end of the body is threaded to fit the clamping nut. Two finger clearance slots are also machined in the end of the body to aid in removing the work-pieces from the chuck after the first operation. Four holes are drilled and counterbored in the bolting flange for cap-screws to fasten the chuck to the faceplate. The faceplate to be used can be tapped to suit these holes.

A clearance hole is machined in the clamping nut to clear the small ends of the work-pieces that project from the end of the body of the chuck when the holes and the seats are being machined in those ends. The outside diameter of this nut is knurled to provide a good grip when spinning it on and off the body of the chuck. Eight holes are drilled around the outside diameter of the nut, into which a piece of drill rod can be inserted to aid in tightening or loosening the nut.

A hardened locating plug is driven into the

bottom of the flange end of the body. This plug is made a slip fit for a 1.000-inch diameter hole bored in the center of the faceplate to be used.

## Template-Located Jig Speeds Drilling and Counterboring

By ROBERT MERY

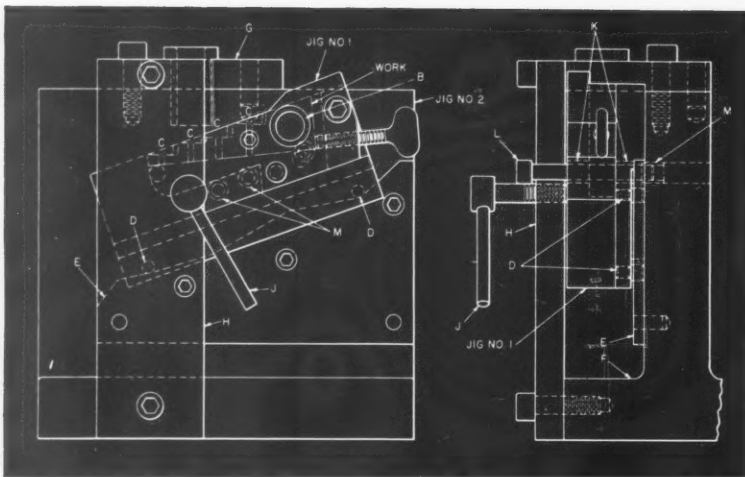
Liberty Products Corporation, Farmingdale, L. I., N. Y.

Frequently a set of holes has to be drilled and counterbored in a part with uneven spacing between the holes, which may be at different angles, and with odd spacing of the counterbores. This problem generally requires complicated tooling, and may slow up machining operations. To minimize these difficulties, the equipment shown in the illustration (see next page) was built, which consists essentially of two jigs.

In operation, the wedge-shaped work is first placed in jig No. 1, and drilled and reamed through bushing liner *B* on a drill press. Locating and clamping of the work is simple, and requires no description. The jig is then removed from the drill press and placed in jig No. 2 on a second drill press for drilling and counterboring the four holes *C* in the required locations.

Two pins *D* in jig No. 2 contact template *E*, which is doweled and screwed to the cast-iron fixture block *F*. A top plate *G* holds the principal liner for slip bushings. A bridge *H* is provided for lock-screw *J*. Jig No. 1 is brought into position for counterboring by sliding it along template *E*, so that index-pin *L*, passing through two axially aligned bushings *K*, enters the four bushings *M* in consecutive order.

Pins *D*, in contact with the template, together with the index-pin, provide three locating points that place jig No. 1 at the exact angle required



Two jigs used in combination with a template simplify the drilling and counterboring of unevenly spaced holes

for drilling and position it correctly for counterboring to the specified depth. When the index-pin is in position, lock-screw *J* is applied, after which the work is drilled and counterbored. To perform this operation at the next position, the screw is unlocked and the index-pin is moved from one bushing *M* to the next one.

### Tensioning Holder for Coiling Spring Wire

By W. M. HALLIDAY, Southport, England

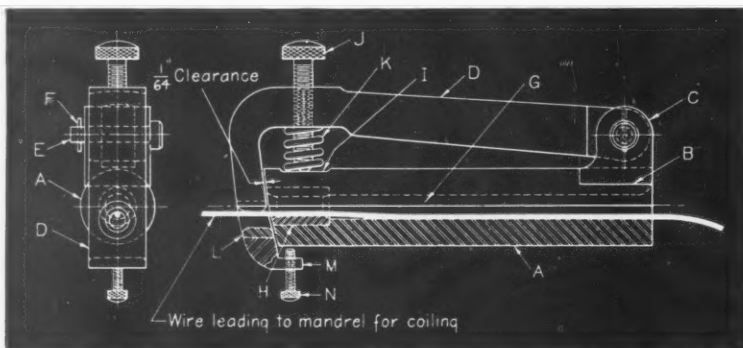
The hand tool illustrated below is used in making tension or compression springs for winding the wire on a mandrel rotated in a lathe. It insures uniformity of coil size and spacing, and eliminates the cuts and bruises often inflicted on the hands of operators performing this task. In addition, it provides a means of applying the constant degree of pressure necessary to insure the proper tension on the wire, and simplifies controlling and guiding the long free end of the wire.

The tubular steel body *A*, which is about 1 inch in diameter, has a flat *B* machined on one side at the right-hand end, to which is brazed or welded a slotted mild steel shackle *C*. Fitting freely into

the slot in this shackle is a steel tension arm *D*, the right-hand end of which is reduced in width to suit the slot. A fulcrum stud *E* anchors the tension arm and permits it to swivel. The stud is prevented from moving in an endwise direction by the stop-pin *F*.

The bore *G* of tube *A* may be any convenient diameter, but to insure adequate capacity for the tool it was found advisable to make this diameter not less than one-quarter the outside diameter of the tube member. The mouth of the bore at the right-hand end of the tube is chamfered, and at the opposite end it is enlarged concentrically to provide a tight press fit for the hardened steel bushing *H*. The bore of this bushing is smoothly polished, and is slightly smaller than the diameter of hole *G*. Each end is well rounded in order to prevent any interference from occurring when the wire is being passed through the tube *A*.

A shallow flat *I* on the outside of the tube is in axial alignment with the shackle member *C* on the opposite end. A knurled screw *J*, threaded through arm *D*, abuts against this flat and compresses a coil spring *K*, which exerts pressure against arm *D*. The curve on the inside face of the bent portion of arm *D*, measured from the center of the fulcrum, provides a clearance of approximately 1/64 inch between that face and the formed end of the tube *A*, which has a sim-



Simple hand tool that facilitates coiling wire on a rotating mandrel in producing tension or compression springs

ilar curve. The end of the hardened bushing *H* is also formed to exactly the same radius.

A hardened and polished steel guide bushing *L* is pressed into the lower end of the bent portion of arm *D*. The guide bushing is located on the same lateral center as bore *G*, but is aligned vertically with the bore only when arm *D* is in its highest position relative to tube *A*.

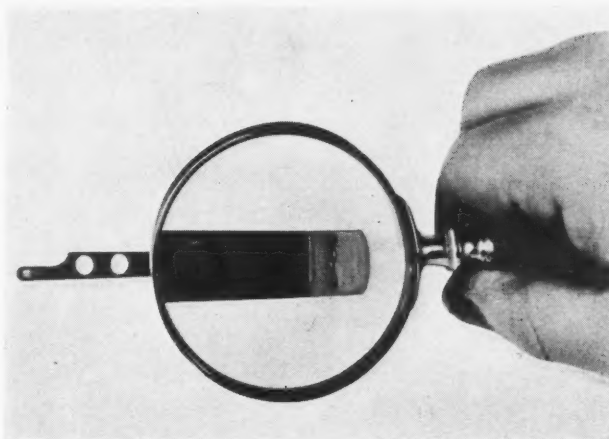
At the extreme lower end of arm *D* is a step *M* through which a small check-screw *N* passes. The step is far enough below tube *A* to permit arm *D* to swing radially about fulcrum *E* for a distance slightly greater than the diameter of the hole in bushing *H*.

In using this tool, the spring wire is freely threaded through bore *G*, from right to left. The adjusting screw *J* is then released to allow arm *D* to move sufficiently so that the wire can be passed through bushing *L*. After the foremost end of the wire has been gripped in the lathe mandrel, ready for coiling, the arm *D* is pushed down, thus providing a tension on the wire, which is regulated by the setting of screw *J*. In this position, the bores of bushings *H* and *L* will be out of line a sufficient degree to provide a certain amount of friction on the wire.

The tool is held in this manner throughout all the subsequent coiling of the wire on the rotating mandrel. Once this operation has started, the operator will quickly discern whether sufficient tension is being maintained, and adjustments can quickly be made to increase or diminish the tension by moving screw *J* a slight amount.

Should it be necessary to stop the coiling operation for any reason before the spring has been completely wound, the device can be gripped tightly to the wire merely by turning screw *N* until it contacts the side of tube *A*. The hand gripping pressure on arm *D* may then be relaxed without fear that the arm will move away from the tube and release tension on the wire. Having thus gripped the wire in the holder, the whole device can be slipped behind the toolpost to prevent the wire from uncoiling on the mandrel.

This device will also prove very useful for straightening out kinks and bends in the spring wire, and also for straightening wire used for other purposes. These kinks will automatically be corrected by merely passing the wire through the two offset bushings *H* and *L*. Since passing the wire through such a device in no way damages the polished surfaces, the tool can often be used in cases where straightening cannot be performed quickly or safely by conventional means. If bore *G* is of sufficient size, the holder can be employed successfully for a large variety of wire diameters.



View showing crack in bend of nickel-silver switch element which is typical of fractures frequently occurring in producing work of this type

### Method of Eliminating Fractures in Bending Nickel-Silver Alloy

A common problem encountered in metal-working shops is the fracturing at bends of strip and sheet metal, cold-rolled to suitable temper for spring applications. In most cases, bends are at approximately 90 degrees, and the forming tool is knife-edged, practically void of any radius. Fractures of this kind were avoided by the Riverside Metal Co., Riverside, N. J., in bending a nickel-silver switch element to a small radius, as described in the following.

The alloy used (ASTM B122-49T, Alloy No. 4) in this part comprises 55 per cent copper, 18 per cent nickel, and 27 per cent zinc. The temper is extra hard, with a corresponding tensile strength of 102,000 to 115,000 pounds per square inch. The blanking direction of the part was 45 degrees relative to the direction of rolling. The part was bent at 90 degrees, and a knife-edged forming tool was used.

The problem was to form the part without fracture and still retain the same blanking direction and basic tools. This was accomplished by employing a 0.005-inch radius at the bend. A 45-degree angle as a blanking direction for parts is not advisable, since the bending properties decrease very rapidly at this point. The best forming properties, of course, are obtained by forming in the direction of rolling. However, a blanking direction of 30 to 35 degrees provides the best combination of economy and forming and spring properties.

\* \* \*

Mechanical power is said to supply over 90 per cent of the total work-energy output in America, while people supply about 3 per cent.

## New Metal-Treating Process Facilitates Cold-Working

A new chemical metal treatment that facilitates the cold-working of steel is the result of joint research conducted by the Heintz Mfg. Co. and the Pennsylvania Salt Mfg. Co., of Philadelphia. The new development, known as the Pennsalt Foscoat process, consists of cleaning, pickling, and the application of a phosphate coating and specially developed lubricants to steel. A heat-resistant lubricating surface is produced, which is chemically interlocked with the steel, and therefore possesses exceptional adherence even under the most severe working conditions.

Of especial importance to industry are the results attained with the new process in such applications as tube drawing, wire drawing, deep-drawing, deep-stamping, cold-heading, and similar cold-working operations. Such operations are generally limited by the possibility of providing effective lubrication and by the ductility of the metal. The former limitation is virtually eliminated by the chemically bonded lubrication film imparted to steel surfaces by this process. This improvement in lubrication eliminates intermediate press operations, as well as annealing and chemical treating operations, and considerably extends the life of the dies.



This cup was formed in a single press operation from a steel billet treated by the Foscoat process. An over-all reduction of approximately 50 per cent was obtained

In wet-drawing of fine steel wire, use of the Foscoat process resulted in a 40 per cent increase in the rate of production, and despite this speed-up, the die life was increased 2 1/2 times. In dry-drawing triangular and square shaped steel wire from round stock, one application of this process permitted drawing to finished shape without the intermediate annealings and the re-coating required with previous processes.

By a single application of the Foscoat process in deep-drawing steel cartridge cases, 80 per cent reductions of wall thickness were possible without intermediate annealing. In cold-extrusion, the process often eliminates the necessity for forging or upsetting heated billets.

\* \* \*

## General Electric Announces Productive Maintenance Program

A new plan to help industry get the most productivity from its existing facilities has been announced by the General Electric Co. Called "Productive Maintenance," the plan is designed primarily to assist maintenance engineers in setting up a program to minimize lost production time and forced idleness due to equipment failures. It will also provide better spare parts control and smoother production flow.

The Productive Maintenance Plan recommends an adequate staff of trained maintenance men, armed with the tools needed to perform properly the functions of regular, routine checks of operating equipment, and planned "outage" of this equipment at regular, scheduled intervals. Rebuilding and modernizing machines during periods of planned "outage" are readily accomplished with an adequate stock of mechanical and electrical renewal parts.

To help the maintenance engineer, the company offers the Productive Maintenance kit—a file-size package of maintenance aids to guide him in setting up a working program. The kit contains an instruction bulletin, a typical balance sheet for keeping historical data on each machine, planned "outage" forms, and check lists for motors, control, and other equipment.

Supplementing the kit, a new slide film entitled "Productive Maintenance" will be available this fall through the local G-E offices. The film explains how this plan can benefit every industrial plant. In order to further aid maintenance engineers establish these programs, G-E Service engineers, upon request, will assist in making a complete equipment survey to determine existing conditions and future "outages," as well as to guide in setting up a working spare parts control.

# THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER  
Lester and Silver  
Sales Management Engineers  
New York and Philadelphia

## Let's Play the Game Right

SOME prosaic and factual observer has defined the game of golf as "the art of placing a diminutive ball successively in eighteen small widely separated holes, according to absurd restrictions, and by the use of tools illy adapted for the purpose." There is a close parallel between playing golf and selling machine equipment. Here are fifteen marks for success:

1. Make sure we know and follow the rules—the principles we play or sell by. If we don't, we won't have friends to play with or against.

2. Don't let anyone talk us out of winning while we dress to play or approach the tee. Anything is possible if we only play the game right.

3. Take a few practice shots—not, of course, facing the pin. These are mental preparations for interview and sale.

4. Study the lie of the ball—that is, our equipment and the needs of the particular prospect. We can't set up our ball in the fairway, rough, or traps. We accept our lie, and make the best out of it. No one likes the "hard luck" player.

5. Study the distance, the traps, and the rough to avoid trouble. These represent the prospect's situation and our own, and the hurdles of competition. The terrain governs the kind of shot we intend and hope to make. Though noticing obstacles, don't be so obsessed with them as to lose confidence and objective.

6. Select the right club—the sales tool to use and sales argument to apply. Pick exactly the one for each timely shot, from niblick to putter.

7. Assume the proper stance—feet firmly on the ground. Get our mind and personal make-up all set right for the sales interview.

8. Fix our eye on the ball and keep it there. Don't lift it—get distracted and confused.

9. Take a swing and follow through, with plenty of deliberate "umph." Don't just take half a stroke and slice, hook, or top the ball.

10. Time each stroke. We all know the club head should strike the ball at its point of maximum velocity. Selling's the same way.

11. Replace the divot. All of us cut up the turf, but too often rush on and leave an ugly scar. Repair the fairway, and leave our track of customer confidence clean.

12. Relax between strokes. Don't get hot and bothered. Now's the time to size up the shot just taken and learn from experience. Take this chance to develop our good humor and the friendship of the other fellow.

13. Avoid chatter. Don't talk when the other fellow is getting set to play. All right to watch and listen, but don't interrupt when the prospect's in turn.

14. Consider the importance of putting—the critical moment in customer contact, when missing just a two-foot putt is as bad as flubbing a long brassy on the fairway. Here we must be under full control.

15. Keep the right score. You know the fellow who actually takes six strokes, and then as you walk away from the green, hesitates and innocently says, "Put me down for a five." Have our facts right and keep our records clean.

Then when we play the nineteenth hole in the locker room, relax and have a good time. But don't carry entertainment too far. Don't get "heady"—that is bound to throw our game off the next day.

Don't forget to practice. Take a batch of balls, pitch them carefully on a practice green, and then putt them. Nothing throws a long hitting opponent off balance more than to be beaten by a careful short-distance player, who is always on the fairway and master of approaching and putting.

Yes, golf is a wonderful game—and selling is too!

## LATEST DEVELOPMENTS IN

# Shop

### Michigan High-Speed Gear-Hobbing Machine

A gear-hobbing machine incorporating new design principles developed for faster production of accurate gears and splines by the hob-generating process has been announced by the Michigan Tool Co., Detroit, Mich. This new high-production machine is shown in Fig. 1 equipped to hob the teeth in two 9-pitch, 22-tooth helical gears in fifty-eight seconds, which have a diameter of 3 1/8 inches and total face width of 2 inches.

The gears are of SAE 5130 steel having a Brinell hardness of 170 to 207. They have a helix angle of 31 2/3 degrees and are cut to close tolerances with an accurate three-thread unground high-speed steel hob, using a cutter speed of 290 surface feet per minute and a feed of 0.125 inch per revolution of the work.

The Model No. 1458 machine illustrated will hob gears from 2 1/2 to 8 inches in diameter. It

will cut a gear or gears having a total face width of 4 3/4 inches. The maximum hob diameter is 7 inches; maximum hob length, 7 inches; and minimum hob diameter (recommended) 2 1/2 inches. The maximum center distance between hob- and work-spindles is 7 1/2 inches, and minimum center distance 2 1/2 inches.

Spindle speeds up to 1000 R.P.M., or more, can be used, and the feed per revolution of the work-spindle is infinitely variable by hydraulic control. Maximum swing of hob-spindle is 35 degrees either side of the center position. The machine is driven by a 15-H.P., 1800-R.P.M. motor, occupies a floor space of only 84 by 84 inches, and weighs 2100 pounds.

When the machine is in use, the operator merely places the work into or on the headstock spindle and pushes a button which starts the automatic cycle. First, the tailstock center moves into place under hydraulic pressure, which is maintained continuously during the cut. Next, the hob- and work-spindles start rotating in timed relationship and the hob-spindle column moves forward horizontally, plunge-feeding the hob into the work.

When the hob has been fed in to the proper depth, the feed stops and the work immediately starts to traverse horizontally across the hob. As the end of the work passes the center line of the hob, the hob-spindle quickly retracts out of the cut, the work returns to the loading position, spindle ro-

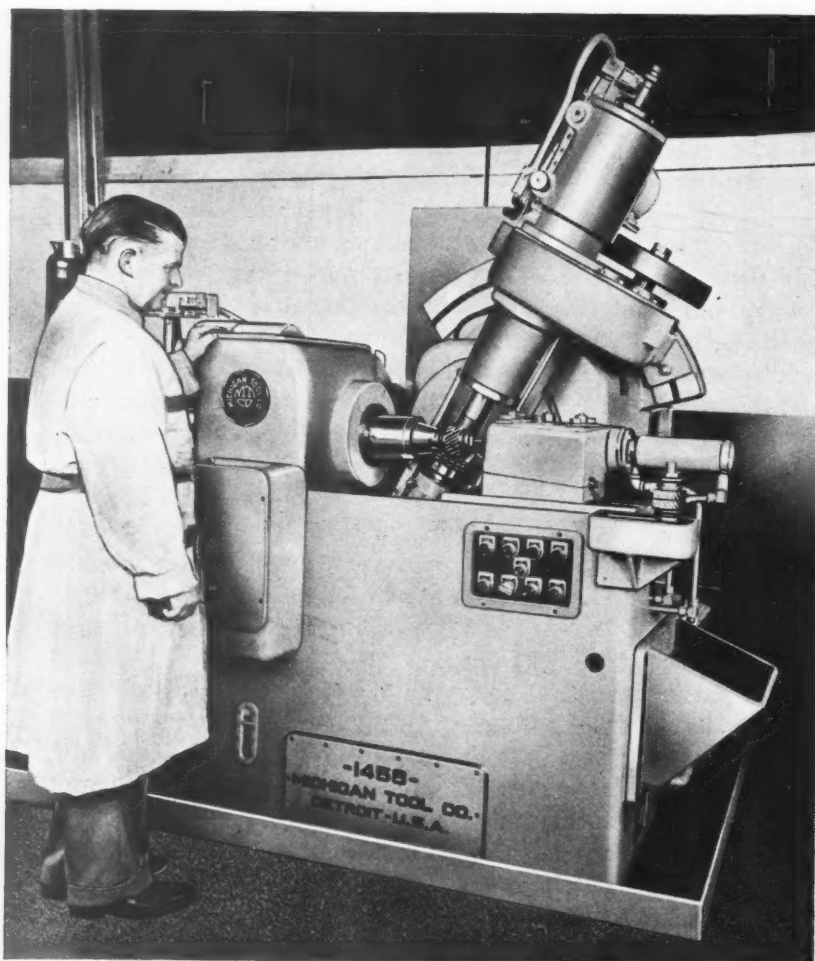


Fig. 1. High-speed production type gear-hobbing machine developed by the Michigan Tool Co.

# Equipment

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on Market

Edited by FREEMAN C. DUSTON

tation stops, and the tailstock center retracts for removal of work and to permit reloading.

Either climb or conventional hobbing can be used, as desired. A specially developed push-button controlled pre-selective hob shifter is optional equipment. When pre-selective hob shifting is employed, to bring a new cutting section of the hob teeth into use, the operator merely presses the hob-shift button. This button is inoperative during the machine cycle. A single counter dial in the electrical panel can be set to the number of increments desired per shift, one increment equalling 0.0029 inch. The position of the hob can be shifted either up or down.

When the full cutting width of the hob has become dull through repeated resetting, a signal light on the push-button panel immediately warns the operator of the necessity for changing hobs.

If for any reason it is desirable or necessary to interrupt the machine action before completion of a cycle, the operator merely pushes the "return" button. The hob then immediately retracts out of the cut, and the work-spindle and tailstock center return to the loading position as the machine stops.

A selector switch permits independent movement of the tailstock center when setting up the machine. Independent switches are also provided for starting the hydraulic pumps, coolant pump, and for automatic or set-up operation. The oil-air-mist lubricator is controlled by a solenoid and works only while the machine is in operation. It provides effective con-

tinuous lubrication, although the oil consumption is only 2 ounces in eight hours. The rotating gears "pick" the oil from the air-mist. The hob and hob-arbor are placed in the machine as a single unit, permitting the hob to be checked between centers for accuracy of mounting, sharpening, etc., before being inserted in the machine.

The total travel of the work during the cut has been reduced by eliminating all except 1/16 inch travel at each end of cut. This has been made possible by the two

distinct and separate feeds used in sequence. They consist of the plunge feed of the hob to the correct depth with its center line just 1/16 inch ahead of the work, followed by the traverse feed of the work across the hob to a point 1/16 inch past the center to complete the cut.

Accuracy of the machine is said to be exceptionally consistent, and appears to depend primarily on the hob. Lead errors are avoided by mounting the lead cam directly on the work-spindle, as shown in

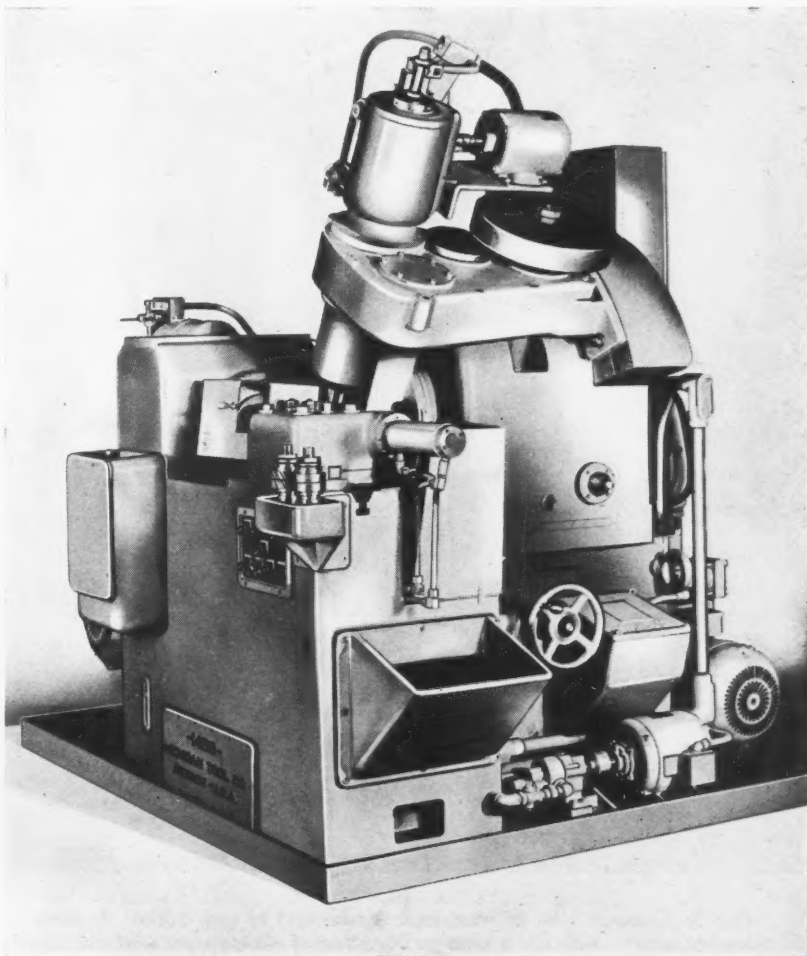


Fig. 2. Side view of gear-hobbing machine illustrated in Fig. 1, showing large chip removal opening

Fig. 3, and virtually eliminating all chance of torsional wind-up in the hob-spindle drive.

The chief factor limiting speed of change-over from one job to another is the use of the helical lead cam to control the accuracy of the lead when cutting helical gears. A complete change-over for a gear of different helix angle requires approximately twenty minutes. The construction of the outboard bearing support permits quick access to the guide assembly for replacing it as a unit, and, if desired, all adjustments can be made in the tool-room prior to a change-over. All machine movements are positively controlled and in accurately timed relationship.

Cone-drive double enveloping gearing is used for the indexing and main-drive gears, supplemented by close fitting, precision-shaved helical gears (spur type ratio and speed change gears) to obtain smooth vibrationless operation at all speeds. Other features developed to assure smooth, quiet



Fig. 4. Cone-drive gear of split construction used in the Michigan gear-hobber. In the event of wear the cam stud (indicated by the arrow) can be adjusted to remove backlash by producing a slight relative shift in the two halves of the gear

operation are dual hydraulic feeds; flywheel for damping out torsional vibration; close-fitting and shaved involute and straight splines fitting in broached bores in place of

keyways; and large-diameter tubular instead of solid shafting for torsional rigidity.

Drive simplification has been accomplished through the use of positive dual hydraulic feeds, which are easily set for any desired feed per revolution by means of a dial on a flow control valve. Precision fitting throughout is employed to eliminate backlash. The hob and work-spindle bushings are designed to serve as ways also, eliminating the need for separate ways. Critical gears, such as the index-gears and the main-drive gear shown in Fig. 4, are provided with adjustable features which have been designed to compensate for any wear that may develop in service. The mechanical, electrical, and hydraulic units and installations are designed to conform to Joint Industry Conference standards throughout.

While manual loading and unloading are easily and rapidly accomplished, the machine is so designed that automatic loading and unloading devices can be used effectively. The work-spindle height is convenient for either method of loading. Fine-pitch screw adjustments on large screws provide means for making accurate and quick settings of the hob-spindle angle and depth of cut for the plunge feed. The latter adjustment is made through the use of a handwheel with a micrometer dial, on which a movement of  $1/2$  inch equals an increment of 0.0010 inch.

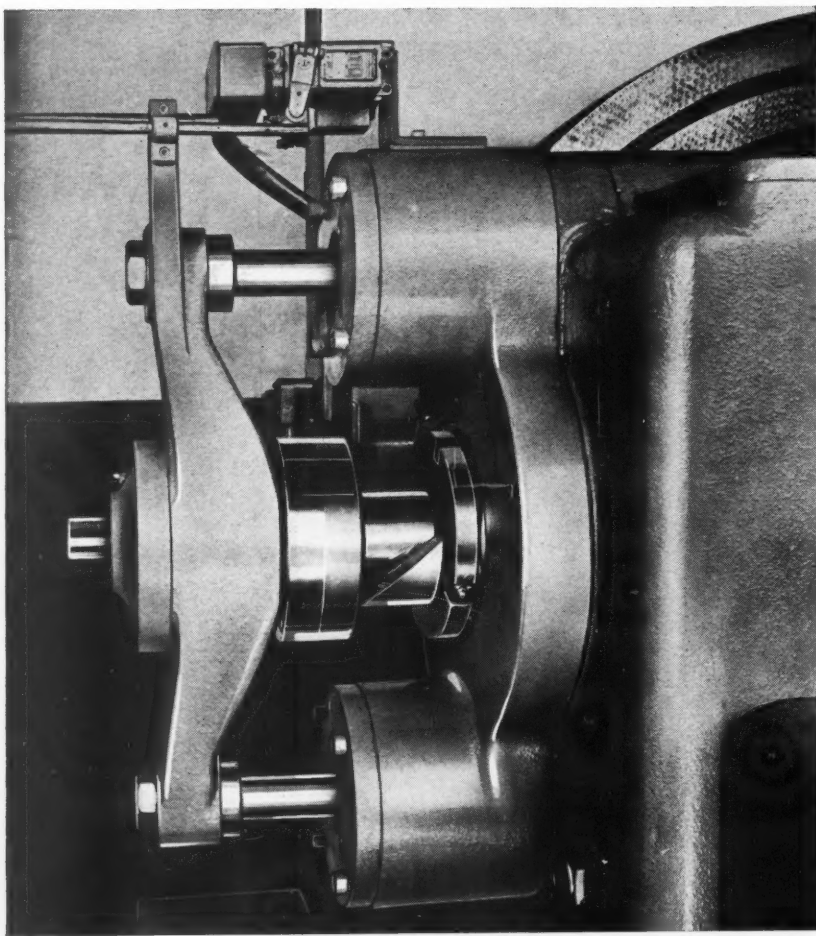
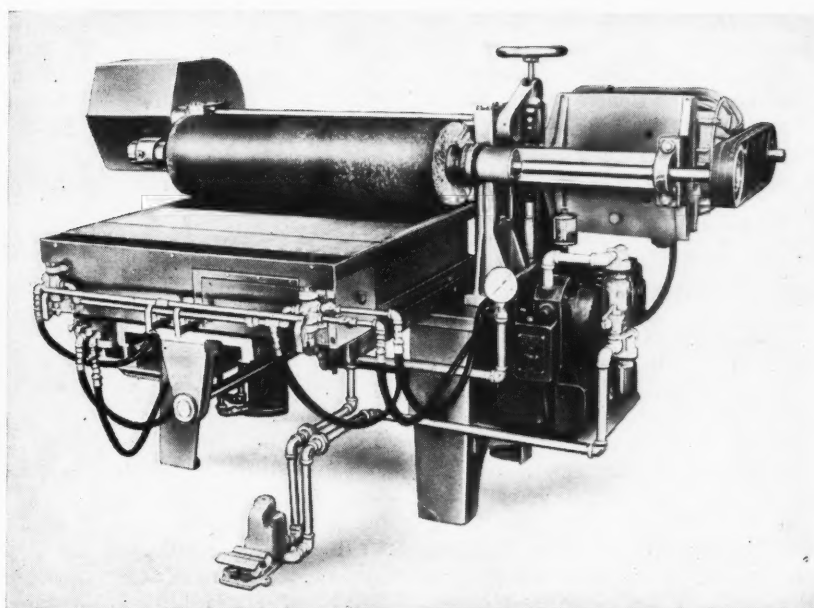


Fig. 3. Close-up view of headstock spindle end of gear-hobber showing lead-accuracy controlling cam-guide mounted directly on work-spindle



Surface finishing machine equipped with vacuum chuck, built by Clair Mfg. Co.

### Clair Surface Finishing Machine with Vacuum Chucking Mechanism

A surface finishing machine capable of holding non-magnetic work on its large chucking surface has been introduced by the Clair Mfg. Co., Olean, N. Y. The vacuum chuck of this Model 203 horizontal electro-hydraulic machine has been developed to solve the problem of holding work made of brass, copper, silver, plastic, aluminum, wood, and other non-magnetic materials.

The moving work-table consists of a perforated plate mounted over a sealed air space connected to a vacuum pump through a four-way spring-return foot-operated valve. The chuck has a maximum working area of 38 by 36 inches and the perforated area is covered by a rubber mat.

In operation, the table moves both in and out and sidewise under the revolving buffing spindle. The length of the in and out stroke of the vacuum table is adjustable from  $3/4$  inch to 36 inches, and the sidewise movement is adjustable from  $1/2$  to  $1\ 3/4$  inches. Raised pads conforming to the contours of the work eliminate the danger of the buff coming in contact with mat.

The machine is protected against harmful action of abrasives. It can be supplied with 5-,  $7\ 1/2$ -, 10-, or 15-H.P. motors. Buffing rolls up to 12 inches in diameter and 40 inches in length

can be mounted on the spindle. An air circuit provides an automatic floating action for the buff at any predetermined uniform pressure.

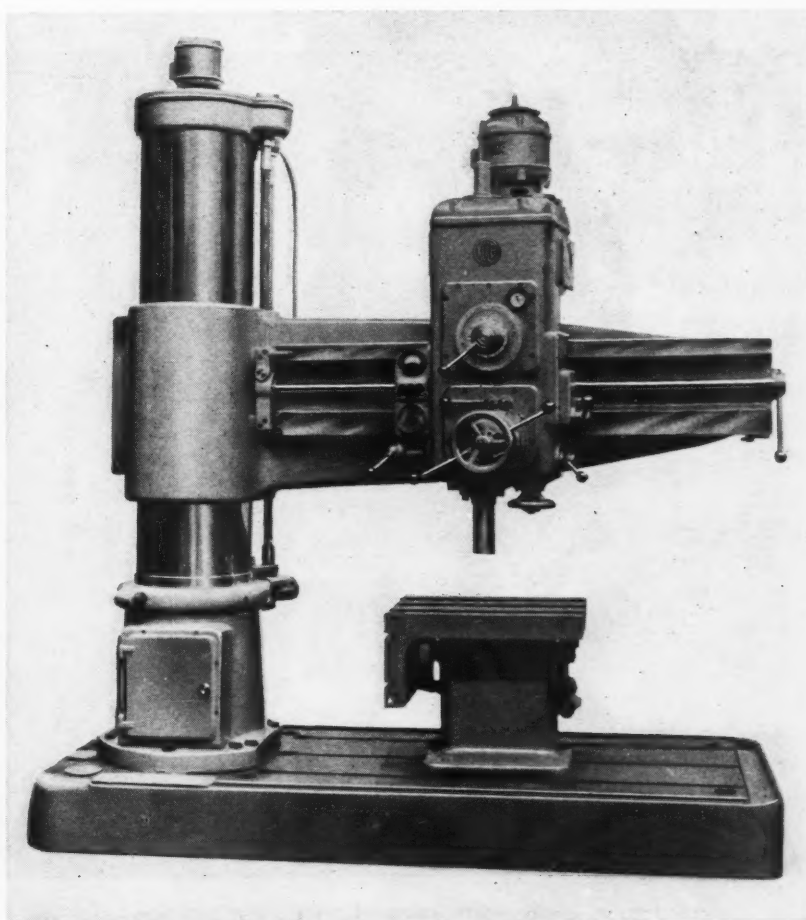
This machine is available with

smaller sized vacuum tables, platform type tables for mechanical holding, as well as a variety of optional modifications. It is adapted for use in surface finishing non-magnetic products, such as cigarette cases, lithograph sheets, blanking stock, etc. 42

### Kolb High-Production Radial Drills

The Cosa Corporation, New York City, is introducing in the United States a line of Kolb radial drills, made in various capacities for light, medium, or heavy-duty drilling operations. These machines have hardened and ground gears, which slide on hardened and ground spline shafts that rotate on ball bearings. Time-saving features include electro-hydraulic mechanism for rigid locking of column and spindle head automatically or by hand; push-button controls; and speed selector.

These machines can be equipped with a device for the pre-selection of feeds for a sequence of rough



Kolb radial drilling machine introduced in this country by the Cosa Corporation

and finish drilling, reaming, and tapping operations. They are made in various capacities for drilling holes from 1 3/8 to 8 inches in diameter in cast iron, and in maximum drilling radii capacities from 27 to 180 inches. Column diam-

eters range from 7 1/2 to 35 inches.

The Model NKR53 radial drill illustrated has twelve speeds ranging from 30 to 1500 R.P.M., and twelve feeds from 0.003 to 0.118 inch per revolution. .... 43

which drives the main pumps; a 3-H.P. direct-current motor, powered by a 3-kilowatt amplidyne generator, which drives the transfer pump; magnetic controls for starting the drives and actuating the valves; and electronic controls for the amplidyne drive. .... 44

## Verson Press Brake With Electronically Controlled Ram Motion

The 1000-ton press brake shown in Fig. 1 is believed to be the first to utilize photo-electric equipment, such as illustrated in Fig. 2, to control the ram motion. By the use of the electronic equipment, the ram of the press can be held level throughout its stroke or it can be operated at a pre-selected degree of tilt within accuracy limits of 0.001 inch.

This new press brake, built by the Verson Allsteel Press Co., Chicago, Ill., is hydraulically operated, the ram being actuated by two independent hydraulic cylinders supplied from separate matched pumps. A reversible booster hydraulic pump is used to transfer oil from one line to another to maintain position synchronization of the ram ends.

The booster pump is driven by a motor supplied by an amplidyne generator, which is controlled by a General Electric photo-electric system. Any tilt of the ram raises or lowers a barrier suspended between the photo-electric cell and the light source. Movement of this barrier as much as 0.001 inch results in automatic correction through altered speed and direction of the oil flow from the transfer pump. Vertical micrometer adjustment of the electronic unit permits the ram to be operated at a selected degree of tilt when required.

The electrical equipment of the new machine, furnished by the General Electric Co., Schenectady, N. Y., includes a 100-H.P. alternating-current induction motor,

## Hydraulic Forming and Drawing Press

The Oilpower Engineering Co., Schenectady, N. Y., has recently developed a low-cost hydraulic forming and drawing press of 50-ton rating, which is designed for continuous operation. The press has a platen area of 25 by 20 inches, a stroke of 10 1/2 inches, and maximum daylight height of 20 inches. It is fitted with a drawing cushion powered by compressed air. The press is equipped with a 10-H.P. motor which drives a piston type hydraulic pump, providing sufficient capacity for operating the press ram at a press speed of 55 inches per minute.

The movement of the double-acting ram is controlled by a fast operating four-way valve. The

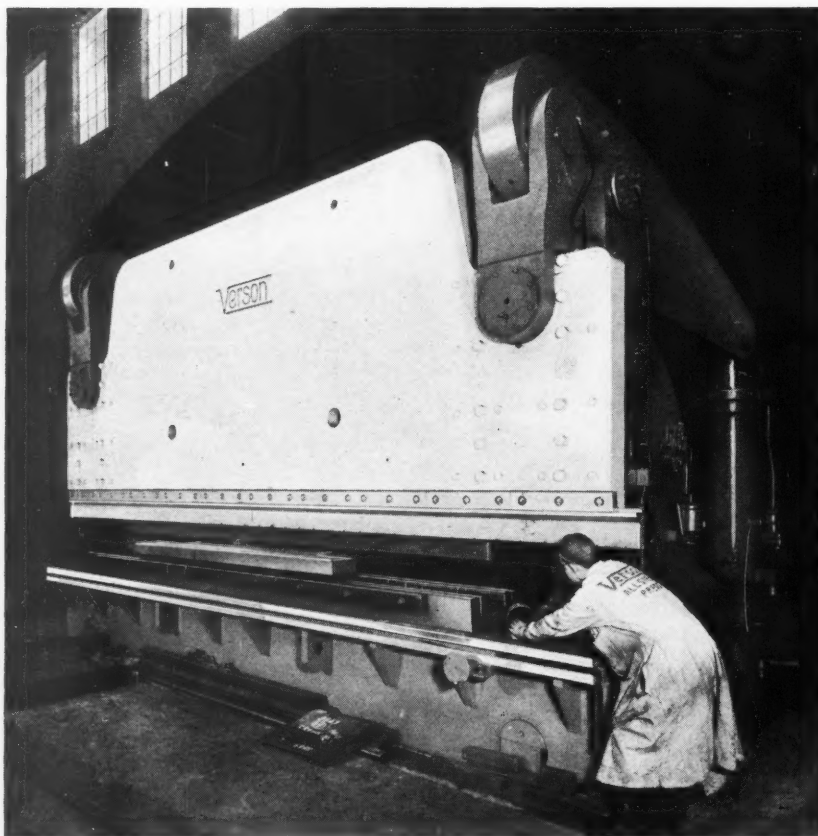


Fig. 1. Hydraulically operated press brake with ram controlled by electronic equipment, recently added to the line of the Verson Allsteel Press Co.

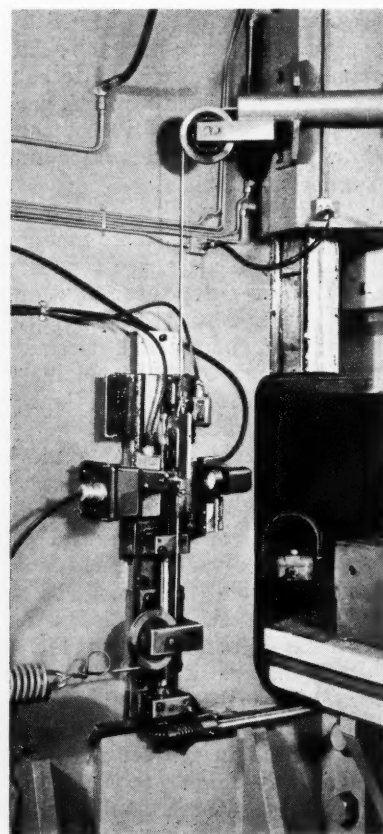
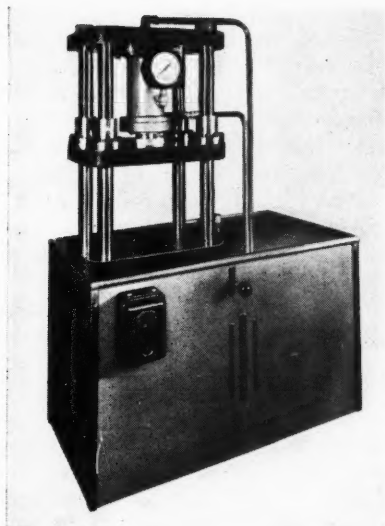


Fig. 2. General Electric photo-electric device used to control ram on Verson press brake



Forming and drawing press developed by Oilpower Engineering Co.

frame of the press is of rugged four-rod construction, and all parts are precision made. The press is designed for drawing to a maximum depth of 5 inches and the pressure-pad will accommo-

date blanks up to 16 by 16 inches. It can also be used for single-acting operation, and will handle a die up to 18 by 20 inches without overhang. .... 45

### Minster Automatic Production Press

The Minster Machine Co., Minster, Ohio, is introducing on the market an automatic production press called the "Piece-Maker." This machine is designed to meet the most rigid requirements for accuracy of alignment needed to produce intricate stampings with progressive dies. It is of the fly-wheel type, with combination air-operated friction clutch and brake. Clutch controls are of the pendent, pedestal, or press mounted types.

Four extra long gibs with eight guiding surfaces control the press slide in two directions, and adjustable bronze ways are provided on each corner of the slide. The slide adjustment is of the long sleeve, manually operated type.

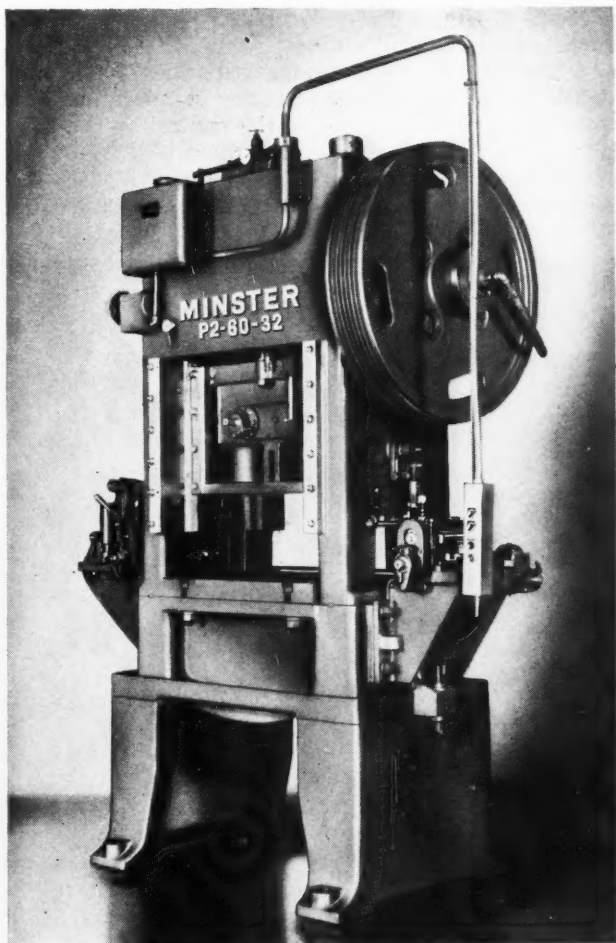
The press is of four-piece tie-rod construction, and is furnished with feed and auxiliary equipment to meet production needs.

The "Piece-Maker" has a double-throw, full-eccentric shaft. The capacity ranges from 20 to 150 tons. All presses in this series are available with variable-speed drives having speed ranges to suit the size and use of the press. .... 46

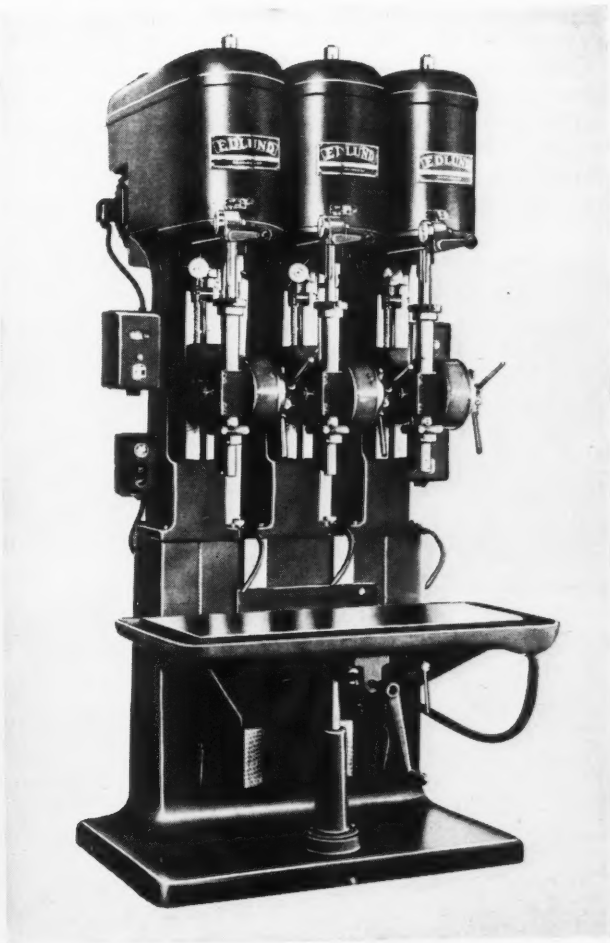
### Edlund Variable-Speed Drilling and Tapping Machines

The machine illustrated is one of a new line of variable-speed single- and multiple-spindle drilling and tapping machines just introduced by the Edlund Machinery Co., Cortland, N. Y. The infinitely variable speed drive with which these machines are equipped is designed to permit selecting the correct speed for maximum production, consistent with efficient tool life.

Speed changes are obtained in-



"Piece-Maker" automatic production press introduced by the Minster Machine Co.



Variable-speed drilling and tapping machine brought out by Edlund Machinery Co.

To obtain additional information on equipment described here, use Inquiry Card on page 229.

MACHINERY, September, 1951—201

stantly by a hand-controlled mechanism, an indicating dial showing the speed selected. Standard spindle speed ranges from 200 to 2700 R.P.M. are available, and additional speeds from 50 to 675 R.P.M. can be obtained through back-gears. The drilling capacity is 3/4 inch in steel (or 1 inch using back-gears) and 7/8 inch in cast iron (or 1 1/4 inches with back-gears).

The standard Model 2F machines are made with one, two, three, four, six, or eight spindles;

in pedestal or round column types; and with 8- or 15-inch overhang from face of column to center of spindle.

Additional equipment includes semi-automatic power feed that engages as the drill touches the work; a reversing motor tapping attachment, capable of tapping thirty holes per minute and reversing at the same depth within one-quarter turn of the tap; and a lead-screw tapping attachment with adjustable stops and interchangeable pick-off gears. -----47

### Baldwin Improved Universal Pyramid Type Bending Roll

A universal pyramid type bending roll of improved design has been built by the Baldwin-Lima-Hamilton Corporation, Philadelphia, Pa., for use in the production of large size pipe. One of the applications for which the improved type machine has been used is the rolling of 31 1/2-foot lengths of 78- and 97-inch wide skelp into 24- and 30-inch outside diameter tubular shapes for high-pressure welded pipe.

Five major design changes have been made in the new bending roll to increase efficiency for production-line operations. First, all three rolls are driven, instead of the two lower rolls only. This

avoids drag and prevents slipping when rolling thin plate. It also eliminates the possibility of stalling under excessive screw-down pressure. Rolls are driven by a 100-H.P. motor, permitting rolling speeds up to 60 feet per minute.

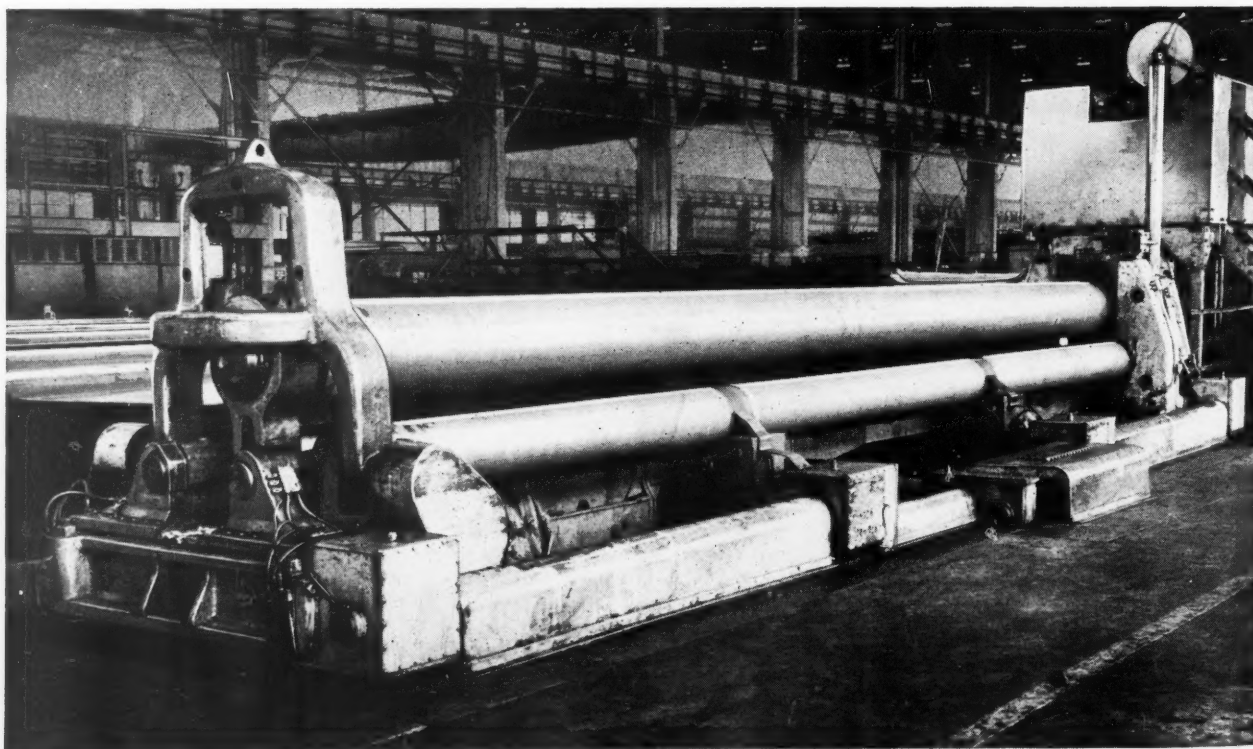
Second, a two-speed differential drive is provided for screw-down adjustment, thus permitting instantaneous change of speed. High speed—up to 30 inches per minute—is used to position the 20-inch diameter top roll, while low speed—up to 12 inches per minute—is employed in applying bending pressures. Maximum clearance between rolls is 6 inches.

Third, the distance between the bottom-roll centers can be varied from 18 to 24 inches by a motor drive. As the bottom-roll centers are adjusted outward, the top-roll loading decreases for a given plate. Thus, the top-roll deflection can be controlled to present a comparatively straight roll surface to the plate. This avoids a "barrel effect" on the cylinder. The machine can be used on plates up to 7/8 inch thick.

Fourth, accessibility has been improved by locating the drop-end hydraulic cylinder in a horizontal position. This also decreases the depth of the pit under the machine. The drop-end housing motion is achieved by the use of the hydraulic cylinder through a lever system and double quadrants. This mechanism automatically locks the drop-end housing in the operating position, and permits actuation from the operator's platform by means of the remote control. ----- 48

### Universal Tool and Cutter Grinders

An improved series of universal tool and cutter grinders has been placed on the market by the K. O. Lee Co., Aberdeen, S. D. This new series includes four models—the basic Model B800 tool and cutter



Universal pyramid type bending roll of improved design, built by Baldwin-Lima-Hamilton Corporation



Tool and cutter grinder of new series built by K. O. Lee Co.

grinder; the Model B860 universal tool grinder equipped with slide-mounted multiple-speed head, which is capable of performing both internal and external grinding; the Model B803 chip-breaker grinder; and the Model B804 universal carbide tool grinder.

These new grinders are de-

signed to meet improved accuracy standards and to have greater machining capacities. They are of 25 per cent heavier construction, have improved lubricating system developed to give longer life, and incorporate many refinements developed to simplify operation. New engineering features have also been introduced to simplify setting up for a large variety of operations.

The machines have a normal swing over the table of 8 1/4 inches, which can be increased to 10 1/4 inches by using raising blocks. The distance between the headstock and tailstock centers is 18 3/4 inches. The table has a

working surface of 5 1/4 by 25 1/4 inches, and the sub-table is 6 1/2 by 30 1/4 inches in size. Calibrations on the left end of the table cover tapers up to 3 inches per foot and angles up to 15 degrees, either side of center. Complete circle calibrations are provided at the center of table. The table has a direct-drive fast-feed traverse of 11 3/4 inches at the rate of 3 3/4 inches per revolution of the crank, and a 5 to 1 ratio slow feed of 3/4 inch per revolution of crank. The cross-feed range is 6 3/4 inches at the rate of 0.100 inch per revolution of the handwheel, which is calibrated in thousandths of an inch. .... 49

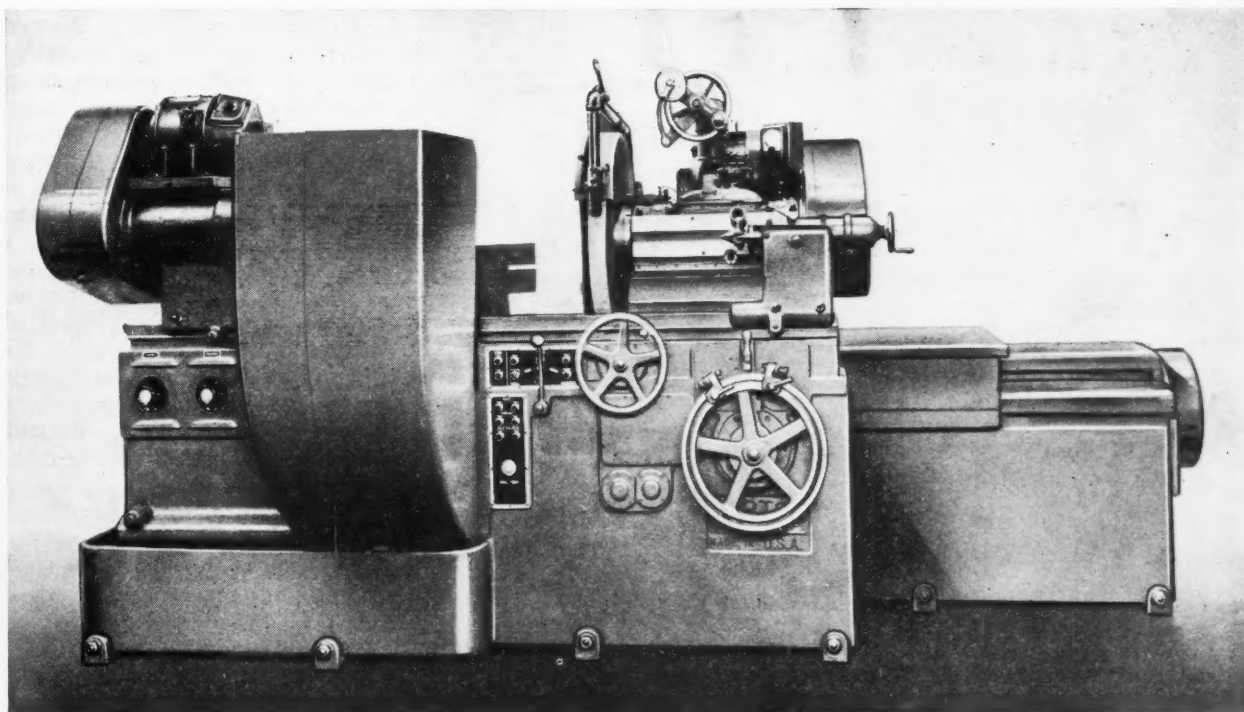
### Norton Aircraft-Strut Grinder

An aircraft-strut grinder built especially for grinding components of landing-gear mechanisms used on large planes has been announced by the Norton Co., Worcester, Mass. This machine has the unusually large capacity required for grinding these mechanisms which, because of their irregular shape and large dimensions, cannot be handled on cylindrical grinders of standard sizes. It is arranged for a 26- or 32-inch diameter swing over the table, and is available in work length capacities of 72 and 96 inches.

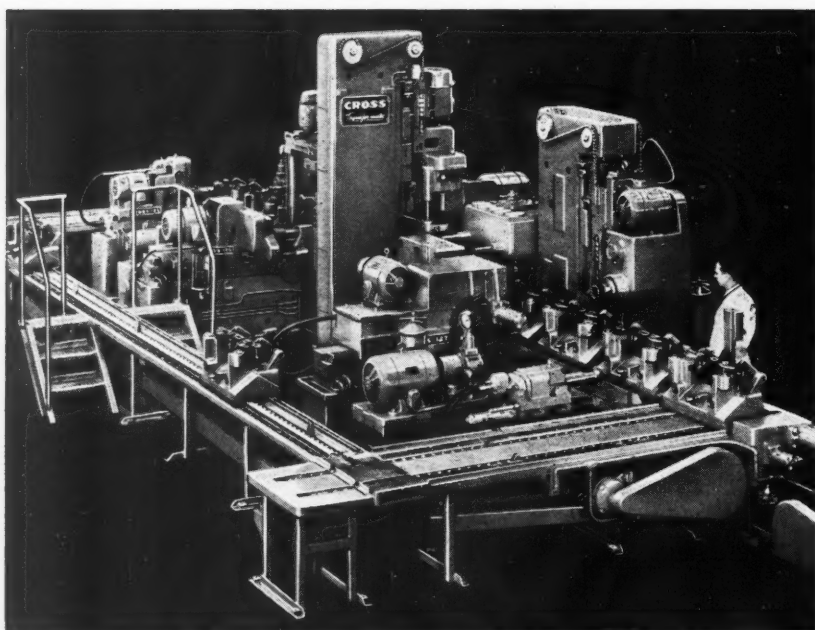
The new strut grinder is pro-

vided with a swing capacity of 80 or 86 inches by means of a gap which is adjustable for width by moving a pedestal on which the headstock rests. The gap may be set for any desired width up to 26 1/2 inches, and has an adjustable-width safety guard.

This machine is of the traveling wheel-head type, the travel being controlled by adjustable dogs on a large wheel at the front of the machine. Tapers can be ground by the use of the swivel table provided. An auxiliary spindle is available for use on parts having projecting members. .... 50



Aircraft-strut grinding machine announced by the Norton Co.



Special machine built by The Cross Company for processing exhaust manifolds in the plant of a large automobile company

### "Transfer-matic" for Machining Exhaust Manifolds

A new Transfer-matic machine has been developed by The Cross Company, Detroit, Mich., for producing exhaust manifolds at the plant of one of the large automobile companies. With this machine, one operator can turn out

130 pieces per hour. The operations include milling the joint face, the hot-spot pad, and the tail-pipe pad; drilling, reaming, chamfering, and tapping all holes; and boring the tail-pipe hole.

This machine has ten stations,

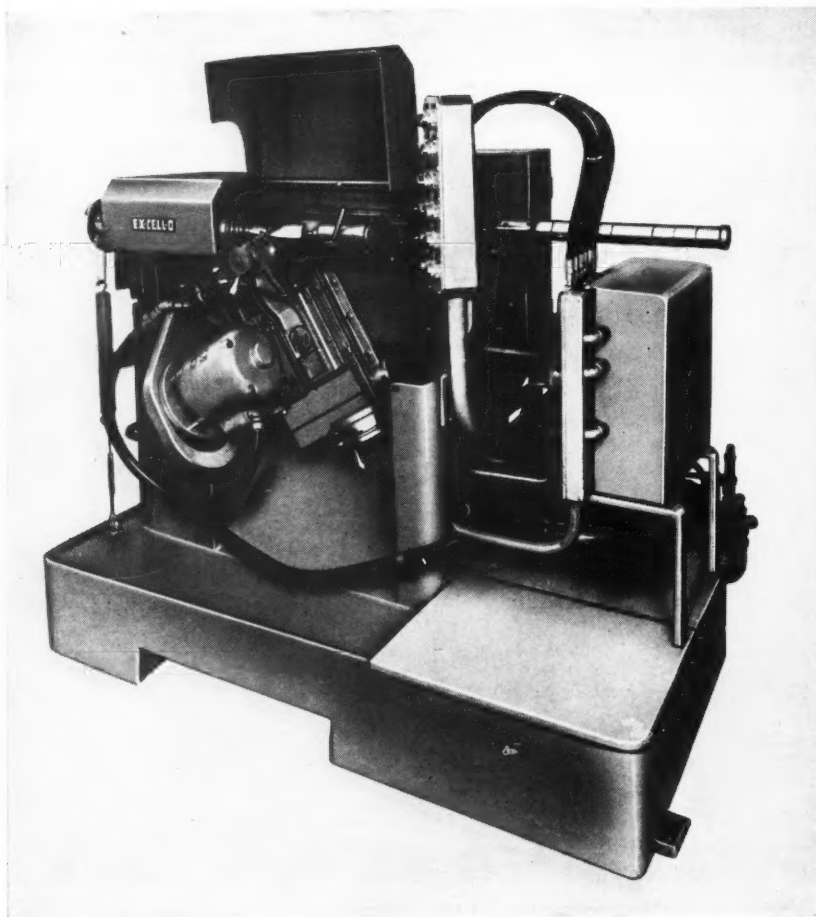
including one for loading, four for milling, four for drilling, reaming, and boring, and one for tapping. The pieces are carried by a unique type of work-holding fixture, which securely holds them between stations and during all operations. The manifolds are clamped in the fixtures by means of a hydraulic power wrench, and are automatically returned from the last machining station to the loading station. Chips are removed by means of a built-in conveyor. Pre-set tools are used throughout the machine to speed the changing of tools and keep "down" time to a minimum. ....51

### Ex-Cell-O Machine for Grinding Jet-Engine Compressor Blades

The Ex-Cell-O Corporation, Detroit, Mich., has brought out a precision profile grinder designed for grinding the airfoil form on jet aircraft-engine compressor blades. This No. 87 machine is similar in design to the No. 86 Ex-Cell-O machine developed for milling jet-engine compressor blades, described in July, 1951, *MACHINERY*, page 233.

The machining cycle of the new grinder is completely automatic, except for loading and unloading the work. The blades are located from the finished root form at one end and from a center in the other end. Accuracy of airfoil form is assured by the use of master cams made directly from the engineer's glass lay-outs.

The new machine grinds the complete airfoil form, including leading and trailing edges. As the work rotates, it moves lengthwise across the grinding wheel at an adjustable feeding rate. Because the area of contact between the work and the grinding wheel is very small at the leading and trailing edges and quite large at the broad sides of the blades, the work speed is automatically changed as



Precision profile grinder with automatic machining cycle designed for grinding the airfoil form on jet-engine compressor blades

Sigma semi-automatic multi-dimension inspection machine for checking turbine and compressor blades and other parts

the blade rotates. Thus there are two periods of fast speed and two periods of slow speed during each revolution, which serves to insure a uniformly fine finish.

Precision grinding spindles are available for any speed required and for any wheel size. The grinding wheel is dressed with a hand-operated, swivel type diamond dresser. The amount of stock removed from the wheel by dressing is compensated for by movement of the wheel in equal amounts toward the work. The wheel can be advanced or retracted without changing its position in relation to the dresser. The coolant equipment supplied with the machine has automatic controls. 52

### Elmes Combination Compression and Transfer Molding Press

A 1000-ton capacity combination compression and transfer molding press, having special safety switches and two push-button control panels for use in a hazardous location, is a recent development of the Elmes Engineering Division, American Steel Foundries, Cincinnati, Ohio. One of the push-button control panels is located near the press, while the other is in a separate room to provide complete remote control.

Operation can be changed from straight compression to transfer molding by simply flicking a switch. In the compression cycle the circuit is arranged to provide two "breathe" periods. Opening during "breathing" can be controlled to 1/4 inch. The curing cycle is controlled by pre-setting a motor type timer, which can be furnished with any required operating range. Compensating control is provided for the pump, so that during the curing cycle only minimum driving power is employed. The lower knock-out is hydraulically operated and is fully automatic. 53

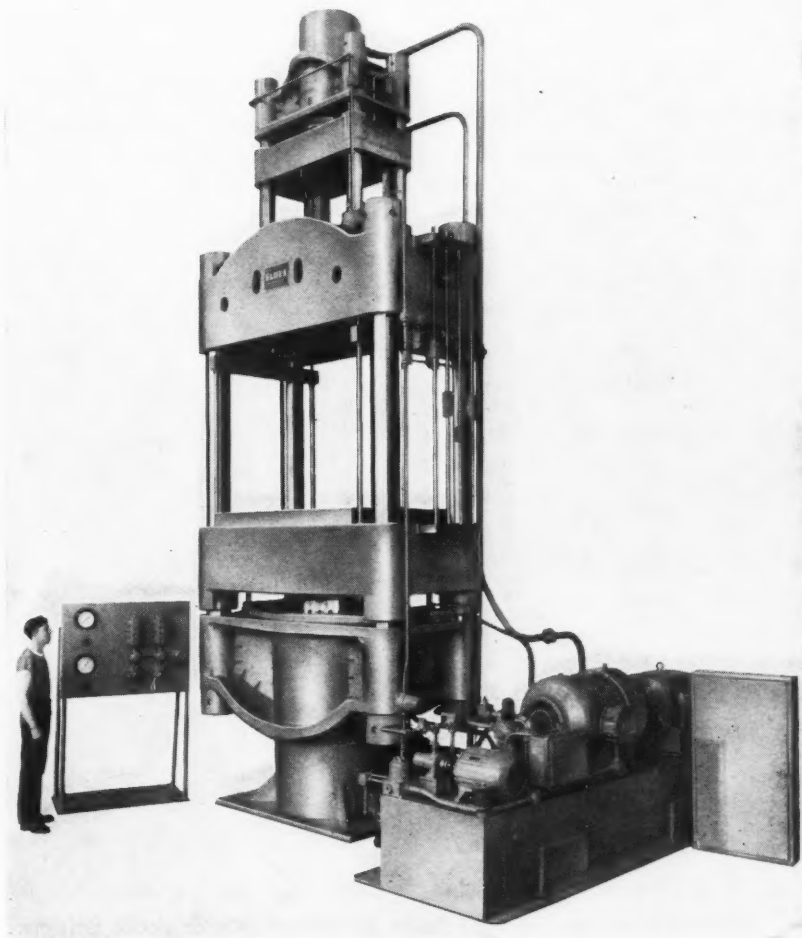
One of a new series of large compression and transfer molding presses built by the Elmes Engineering Division, American Steel Foundries



### Sigma Multi-Dimension Inspection Machine

A multi-dimension inspection machine manufactured by the Sigma Instrument Co., Ltd., Letchworth, England, is being introduced in the United States by the Cosa Corporation, New York

City. This machine is designed for 100 per cent inspection of different types of both large and small parts. It checks pieces simultaneously for inside and outside diameters, depths, profiles,



tapers, concentricity, squareness of surfaces, threads, and other characteristics. As many as twenty-eight dimensions of a turbine blade can be inspected at the rate of 300 pieces per hour. Results are shown by colored lights.

The machine is available for hand, semi-automatic, or fully automatic operation. It is made up of standard units, including bases, light boxes, measuring gages, fixtures, and sorting devices. The tips of the measuring gages, work-holders, and loading magazines or hoppers are the only special parts required for individual set-ups. With proper tooling, set-ups can be changed in about twenty minutes. Up to 10,000 pieces per hour can be checked.

The fully automatic machine is equipped with a device for sorting pieces into three or four groups—those that are O.K.; those that can be corrected; those to be rejected; and those to be graded, if required. The basic checking unit, an electrical signal gage, measures within accuracy limits of 0.00005 inch. The gages are made in four types with measuring ranges from 0.060 to 0.010 inch and with graduations from 0.0003 to 0.00005 inch. .... 54

### Natco Two-Way Horizontal "Holetapper"

The National Automatic Tool Co., Richmond, Ind., has developed a two-way horizontal "Holetapper"

capable of tapping forty-seven holes in twenty automotive cylinder blocks per hour. All operations are automatic. Those performed by the left-hand head consist of tapping eleven holes with 3/4-inch pipe tap; four holes with 1/8-inch pipe tap; two holes with

5/16-inch pipe tap; five holes with 3/8-16 tap; and one hole with 3/8-inch N.P.T. The right-hand head taps thirteen holes with 7/16-14 tap; six holes with 3/4-inch pipe tap; four holes with 1/2-13 tap; and one hole with 1/8-inch pipe tap. .... 55

### Simmons Improved Turret Lathe Designed for Rapid Production of Precision Parts

Remote speed control, helical gears in the headstock, and an electrical tachometer that indicates spindle speed are features of an improved low-cost high-precision No. 2 turret lathe now being built by the Simmons Machine Tool Corporation, Albany, N. Y. Speed changing, formerly done by means of a handwheel, is now accomplished by push-button control. The tachometer can be easily read and speed changes instantaneously made from the operating position.

The "Micro-Speed" drive permits an infinite range of speed changes while the spindle is in operation in either direction. This drive consists of an alternating-current motor and variable-speed drive, mounted on a bracket in the one-piece cabinet base.

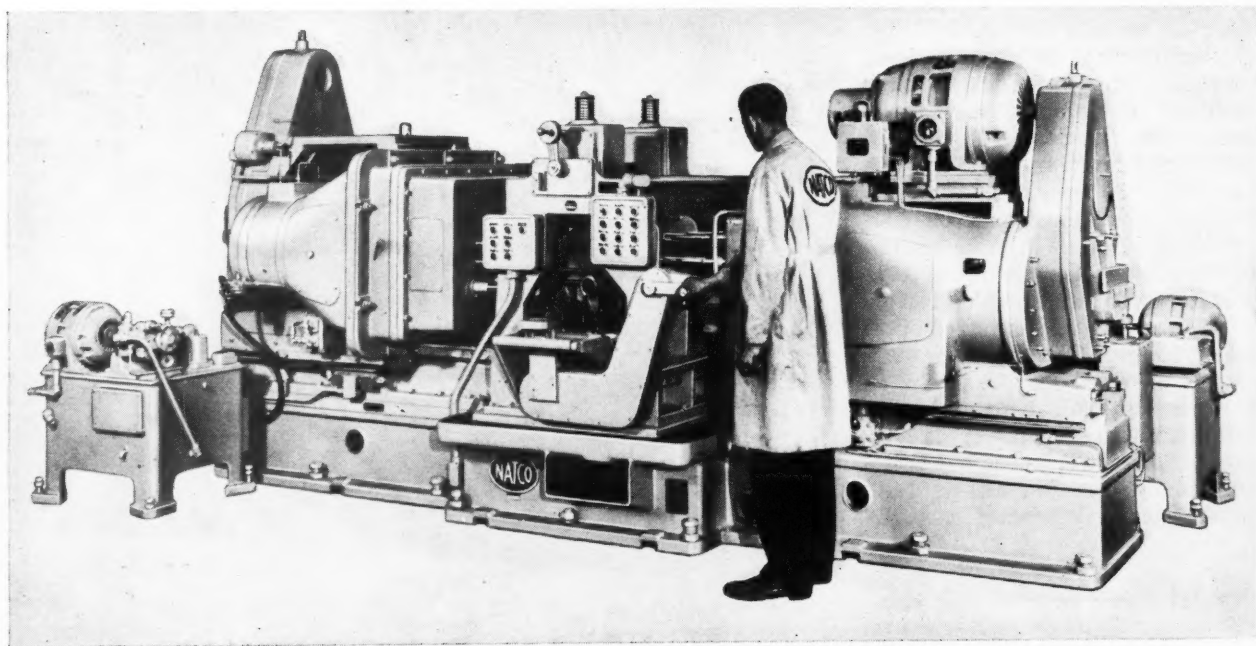
The spindle clutch is especially useful in short-cycle operation, and is of the multiple disc type, which can be readily adjusted for wear. A simple, over-sized brake, operated by the clutch lever, serves to stop the spindle quickly

and lock it to facilitate changing work.

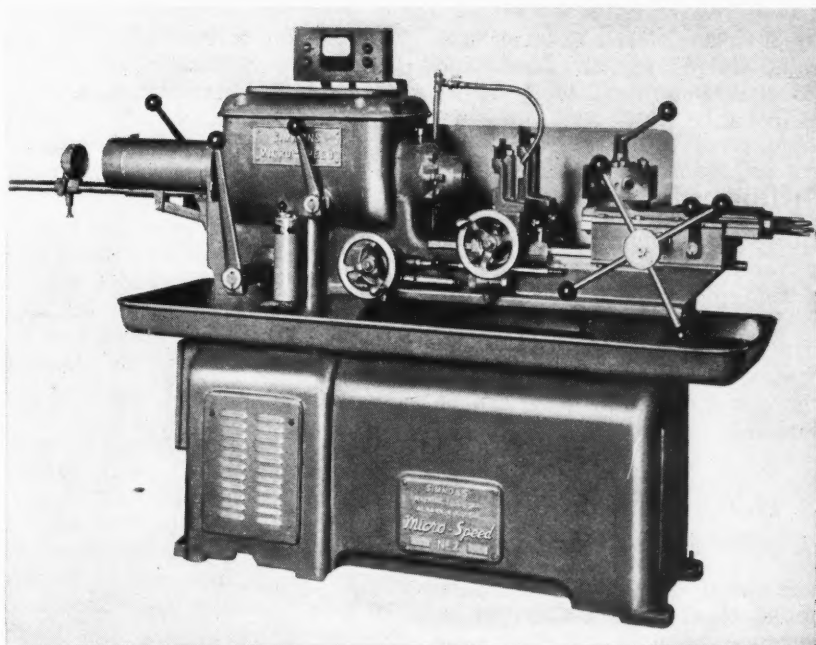
Power feed to the turret ram is provided through a three-speed gear-box and a worm and worm-wheel mounted on the turret saddle. A motor-driven coolant pump assures a constant flow of the coolant at all times.

The swing over the bed of the machine is 14 inches, and over the cross-slide 6 inches. The bed is 7 inches wide, and the ways 31 inches long. The round bar stock capacity is 1 1/4 inches, and the chuck capacity 1 1/16 inches for hexagonal stock and 7/8 inch for square stock. The plunger hole is 1 9/32 inches in diameter, and the spindle hole 1 1/2 inches. The thread on the spindle nose is 2 3/8 inches in diameter and eight threads per inch.

Spindle speeds of the back-gear machine range from 188 to 750 R.P.M. with direct drive, and from 44 to 177 R.P.M. with back-gears engaged. The plain machine with single-speed motor has a spindle speed range of 375



"Holetapper" for tapping holes in automotive cylinder blocks, developed by the National Automatic Tool Co.



Improved turret lathe designed for high-speed production of precision parts announced by the Simmons Machine Tool Corporation

to 1500 R.P.M. The cross-slide has a transverse travel of 5 inches and a longitudinal travel of 12 inches.

The hexagonal turret has tool holes 1 inch in diameter, and is 7 1/4 inches across flats. Power

feeds for the back-geared machine are 0.006, 0.010, and 0.018 inch, and for the plain machine 0.004, 0.007, and 0.012 inch. The plain machine weighs 2800 pounds, and the back-geared machine 2900 pounds. \_\_\_\_\_ 56

### Reed-Prentice Injection Molding Machines

The Reed-Prentice Corporation, Worcester, Mass., has brought out two plastic injection molding machines, of 24- and 32-ounce capacities, featuring rugged tie-bar

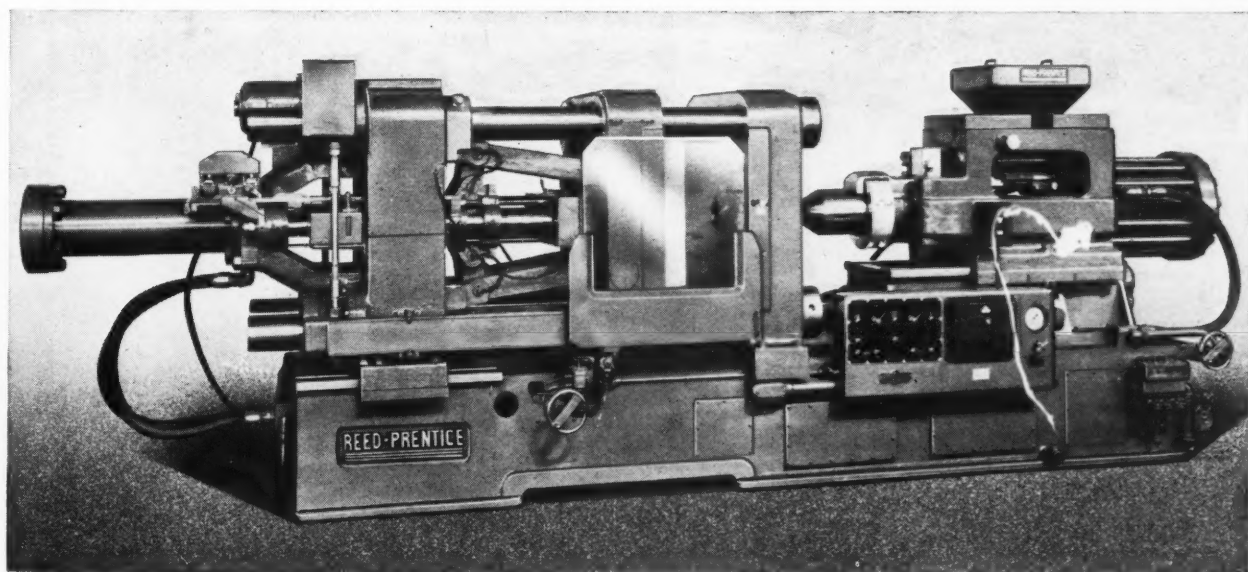
construction. These machines are said to have many molding advantages over the former frame type machines built in the same sizes. They will plasticize 125 and 150

pounds of thermoplastic material per hour, respectively. Both machines, designated Model 600T, incorporate a new mold locking mechanism that develops 600 tons clamping pressure, and provide a full 24-inch stroke, which can be shortened for thin molds. Movement of the link mechanism through four motor-driven nuts on the tie-bars affords easy and accurate mold adjustment.

The central control panel at the front of the machine automatically controls the movement of the die-plate and plunger. The die platens have been increased to 45 by 54 inches to accommodate larger molds and provide a casting area of 300 square inches. The movable die-plate slides on four 6-inch diameter tie-bars, and has additional supports which move on hardened steel ways to assure accurate alignment under all operating conditions.

The large capacity heating cylinder has a copper core spreader for rapid plasticizing and is mounted on vertical ways to permit easy removal. Hydraulic and electrical interlocks for the front safety door assure safe operation. The machines are designed to provide complete accessibility to all piping, electrical controls, and hydraulic equipment. A separate steel cabinet houses electrical controls and proportioning type pyrometer panels for accurate temperature control of the heating cylinder.

Convenient grouping of the motor and hydraulic equipment,



Plastic injection molding machine of improved design featuring rugged tie-bar construction, announced by the Reed-Prentice Corporation

mounted at the rear of the machine, facilitates maintenance. The 24-ounce machine weighs 45,100 pounds and measures 270 by 76

by 80 inches. The 32-ounce machine weighs 46,100 pounds and its dimensions are 280 by 76 by 81 inches. ....57

### Richmond Radial Drilling Machine

A 4-foot radial drilling machine with 9-inch column and a capacity for drilling holes up to 1 1/4 inches in diameter in mild steel, manufactured by Midgley & Sutcliffe, Leeds, England, is now available in the United States through the British Industries Corporation, New York City. This machine, known as the Richmond SR2, is designed for precision drilling. The accurately machined column is ground to receive the arm, and the arm is mounted in roller bearings. The saddle is mounted on needle roller bearings, which permits free movement along the arm under finger pressure. Provision is made for securely clamping the saddle in any position on the arm.

The machine is driven by a 2-H.P. constant-speed reversing motor, flange-mounted directly on top of the saddle. Nine spindle speeds are obtainable through the operation of two levers. The spindle nose is bored to receive a No. 3

Morse taper shank. Rapid hand traverse, fine hand feed, and automatic feed for the spindle are provided, and there is an automatic trip for stopping the feed at any predetermined depth. Either a rigid or swivel type table can be supplied. ....58

### Houdaille Automatic Coolant Clarifier System

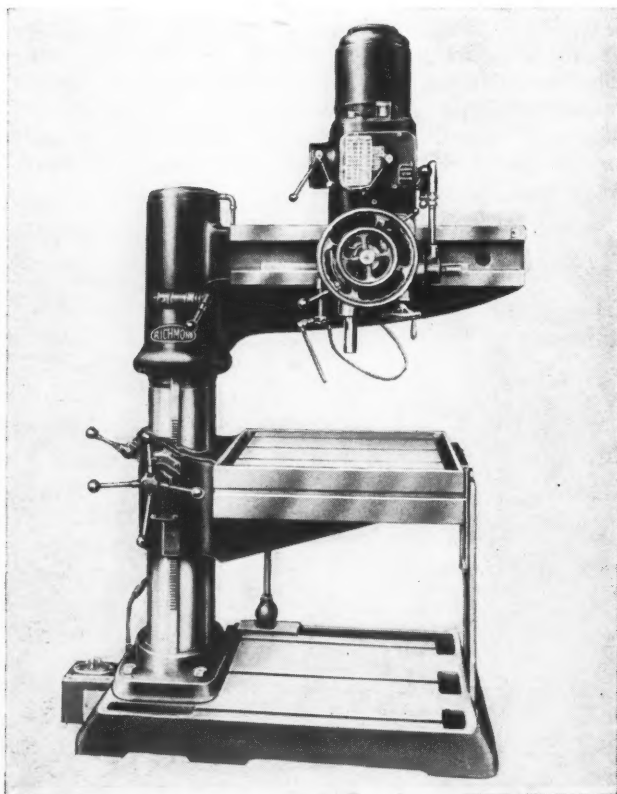
A newly designed Houdaille automatic clarifier system, which removes abrasives and other solid contaminants from machine tool coolants, transports waste to a disposal point, and cleans its own filtering screens in automatically timed cycles is announced by the Honan-Crane Corporation, Lebanon, Ind. This equipment removes particles as small as 5 to 10 microns from the coolant. It consists of a multiple-screen clarifier, a blow-down tank with conveyor, and an automatic control panel.

Contamination removed from the screens by blow-down action settles in the V-bottomed blow-down tank and is automatically removed to the disposal point by the built-in, tube-enclosed chain conveyor.

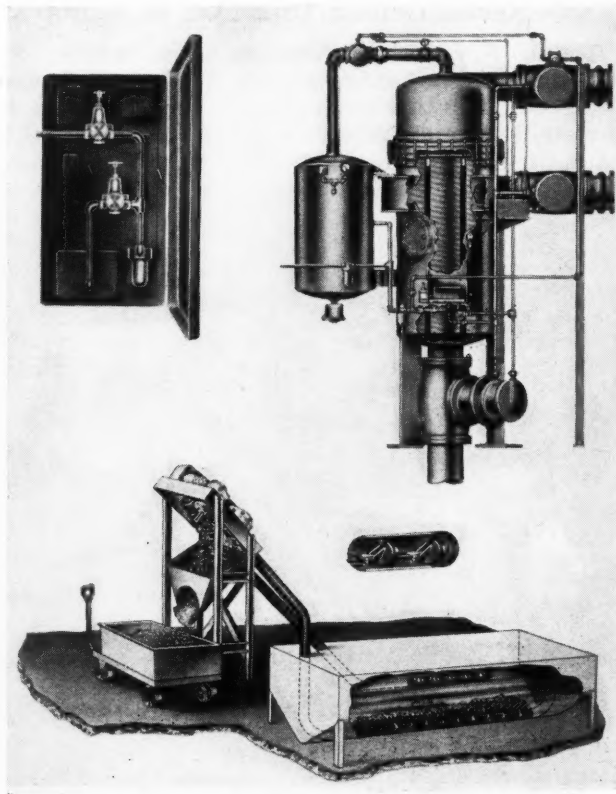
This system is specifically designed for plant operations involving large numbers of cutting and grinding tools served by a central coolant system. It can be used for clarification of mineral oil or soluble oil coolants. By keeping the coolant free from abrasives and contamination, the system serves to increase tool life, provide better finish, and extend coolant life. While built to provide flow rates up to 1000 gallons per minute, the installation of several units in a central system permits handling an unlimited volume of liquid. ....59

### Oilgear Constant-Delivery High-Pressure Pumps

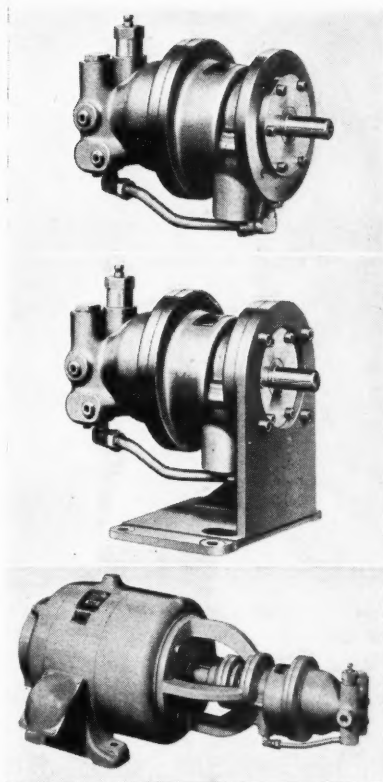
Simplification and compactness are outstanding features of three heavy-duty axial rolling piston pumps recently brought out by the Oilgear Co., Milwaukee, Wis. These new Type HG pumps are said to have fewer working parts and to operate quietly at speeds



Radial drilling machine introduced by British Industries Corporation, International Machinery Division



Houdaille newly designed automatic coolant clarifier recently announced by Honan-Crane Corporation



(Top) Oilgear one-way constant-delivery pump. (Center) Pump with right-angle bracket mounting. (Bottom) Pump with adapter and 10-H.P. electric motor combined to form a complete unit

up to 1800 R.P.M. They are designed for use at pressures up to 3000 and 5000 pounds per square inch, and are made with 3-, 5-, 7 1/2-, 10-, and 15-H.P. motors.

The pumps in the new line are of the fixed-stroke type, the volume of oil delivered varying with the drive-shaft speed. Oil is delivered in one direction. Each unit consists of an axial rolling piston pump, a supercharging gear pump, a gear-pump relief valve, and an adjustable reverse-flow type high-pressure relief valve.

Over 10 H.P. is transmitted by units only 7 by 10 by 13 inches in size. About 135 cubic inches per minute excess gear-pump oil at a pressure of 100 pounds per square inch is available for auxiliary purposes. Pump, work, and machine are all protected against overload.

These pumps are especially suitable for heavy-duty pushing, pulling, lifting, and lowering applications, and for maintaining high static loads on large clamping rams and similar work. ....60

### Sutton Guideless Tube and Bar Straightener

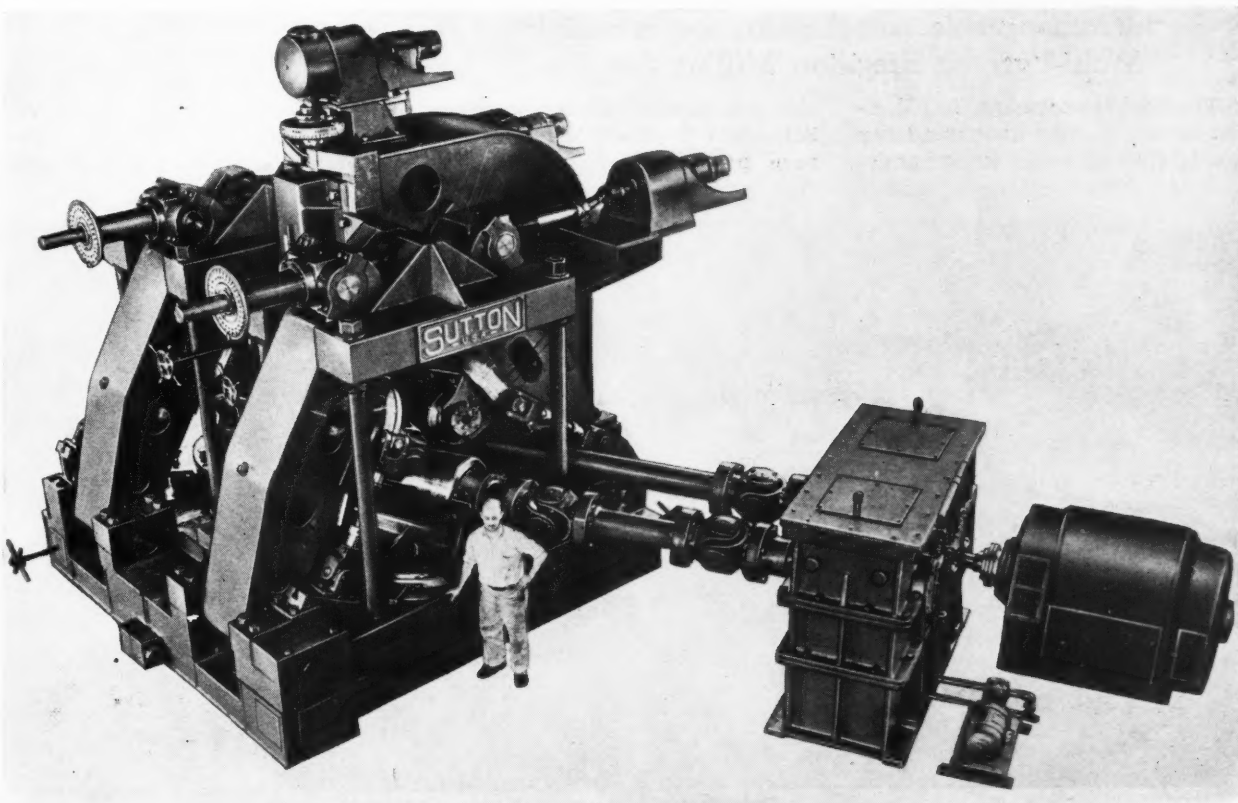
The Sutton Engineering Co., Bellefonte, Pa., has recently built a tube and bar straightener for a tube mill at Milan, Italy, which will be used for straightening tubes having outside diameters of from 4 1/2 to 16 1/2 inches, and solid bars with outside diameters ranging from 4 1/2 to 9 inches.

This No. 5M KTC machine employs seven straightening rolls, one group of three rolls being mounted at the entry end of the machine and another group of three rolls at the delivery end. Each group is composed of one large driven roll and two idler

rolls disposed at an angle of approximately 120 degrees to each other. Located between the two groups is a middle idler roll that serves the purpose of deflecting the pipe during the straightening operation.

This unique roll arrangement eliminates the use of all guides, and at the same time positively confines the bar or tube to the "pass" line throughout the straightening operation. Positive feeding of all material and uniform straightening from end to end are also assured.

An automatic roll-angling de-



Tube and bar straightening machine developed by Sutton Engineering Co.

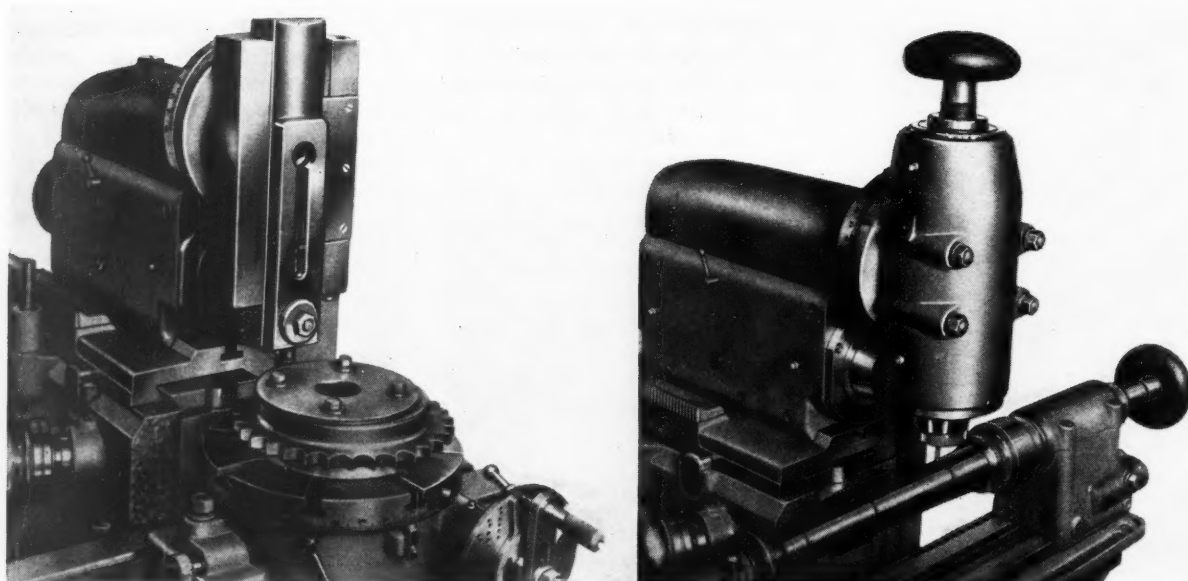


Fig. 1. (Left) Slotting attachment for Schaublin precision milling machine. (Right) Vertical cutter-head, which is interchangeable with the slotting head

vice plus power-operated screw-downs and manual adjustment of middle pressure roll make possible extremely rapid changes to suit different sizes of tubes. For example, the set-up for straightening tubes having an outside diameter of 5 inches can be changed for tubes of 14 inches outside diameter in less than two minutes.

Straightening speeds normally vary between 60 and 240 feet per minute, using a 200-H.P., 300- to 1200-R.P.M., adjustable-speed direct-current motor.

This straightening machine is available in sizes for tubes having outside diameters of 5/16 inch up to 20 inches, and bars from 5/16 inch to 12 inches in diameter. —61

### Interchangeable Attachments for Schaublin Multi-Purpose Precision Milling Machine

The Carl Hirschmann Co., Manhasset, N. Y., has announced the availability of seven interchange-

able precision attachments for the Schaublin Type SV-12 multi-purpose precision milling machine,

described in July MACHINERY, page 239.

This machine is normally supplied with a horizontal cutter-head having a No. 4 Morse taper. The cutter-head slides on a prismatic way, and can be equipped with a plain cover and an over-arm with arbor support. If specially ordered, a vertical cutter-head can be provided, as shown at the right in Fig. 1. The vertical head is identical in design to the horizontal head, is interchangeable with the cover or the over-arm support, and is driven by the horizontal spindle. The head can be inclined to any angle

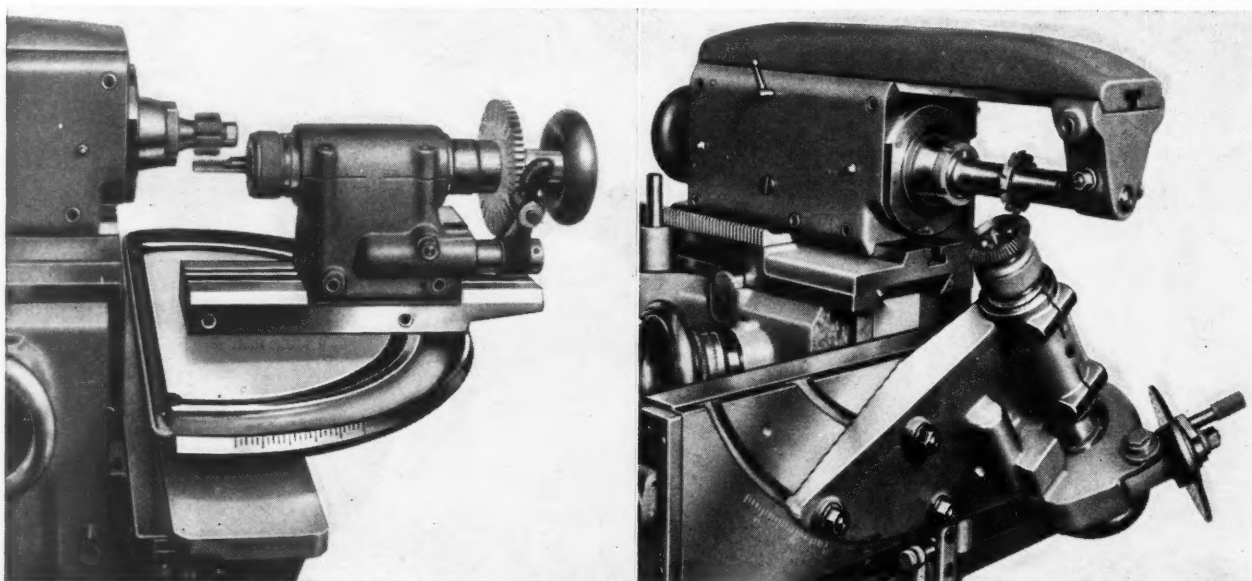


Fig. 2. (Left) Semicircular table attachment with saddle for Schaublin precision milling machine. (Right) Inclinable quill-holder, which is interchangeable with saddle and semicircular table

up to 90 degrees either side of the vertical position.

The slotting attachment shown at the left, Fig. 1, can be interchanged with the cover or the vertical cutter-head, and is attached to the machine in the same manner as the vertical head. It can also be adjusted to any angle up to 90 degrees either side of the vertical position. The tool stroke adjustment range is from 0 to 46 millimeters, and slotting speeds of 50, 75, 135, 210, 335, and 525 strokes a minute are available.

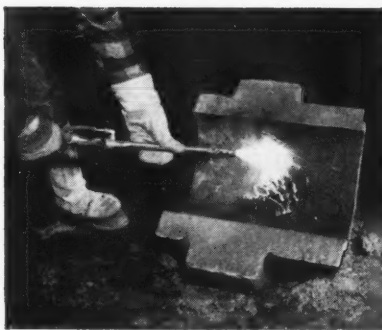
The longitudinal slide of the machine is mounted square with the frame, and has an angle bracket which will accommodate a saddle having the same profile as the bed of the Schaublin lathe; a rectangular table; a rotary circular table; and a semicircular table (shown in the view at the left, Fig. 2). This table has graduations up to 90 degrees each side of the central or square position. The saddle is 11.7 inches long, and will take the quill-holder, with or without dividing plate, or the swivel vise.

When the angle bracket is removed, the longitudinal slide will accommodate an inclinable table; special attachments for specific jobs; and an inclinable quill-holder (shown at the right in Fig. 2). This quill-holder has two circular T-slots, and is graduated for machining at any angle up to 90 degrees. 62

## Oxy-Acetylene Equipment for Removal of Surface Metal and Burned-In Sand

Oxy-acetylene equipment for the rapid, economical removal of sand encrustations, fins, pads, and other excess metal from castings has been developed by Linde Air Products Company, Division of Union Carbide and Carbon Corporation, New York City. The new process employed with this equipment is called "Powder Washing."

A special Oxweld FSC-1 blowpipe with external powder-washing attachment is used. With this apparatus, an iron-rich powder is fed through oxy-acetylene preheat flames into a low-velocity oxygen stream, where it burns and produces superheated liquid iron oxide. Heat from the combustion of the powder and from the slag simplifies and speeds the removal of metal and metal-sand mixtures.



Linde Oxweld blowpipe with powder-washing attachment for removing excess metal from castings

Wherever the powder-fed flame is directed against a casting, the metal surface is brought quickly to kindling temperature, and it is then oxidized and blown away by the oxygen stream. After "Powder Washing," the surfaces of cast-

ings are left smooth, clean, and to close tolerances. There is no under-cutting and no torn metal.

The washing nozzle used with the blowpipe has a large center hole through which the low-velocity oxygen stream is discharged. Around the large hole is a ring of ten preheat flame ports. The powder is discharged from a flat tube above the nozzle. A pneumatic dispenser supplies the powder. Compressed air at a pressure of 6 pounds per square inch carries the powder through a separate hose to the powder-washing attachment.

In use, the blowpipe is simply moved from side to side across the surface of the casting. The oxygen stream is directed against the casting face at an angle of 20 to 35 degrees. The washing operation can be applied to flat or uneven surfaces. 63

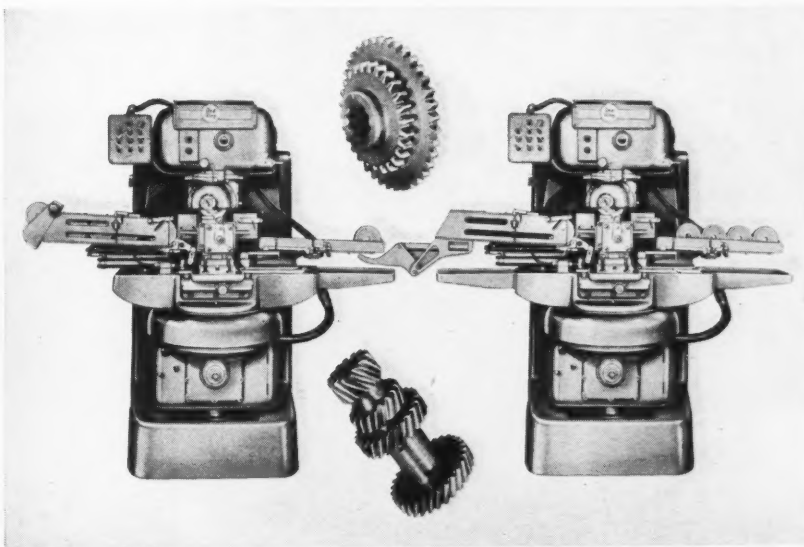
## "Red Ring" Straight-Line Automatic Loader for Gear-Shaving Machines

The National Broach & Machine Co., Detroit, Mich., has developed a straight-line automatic loader which makes possible the continuous automatic shaving of the teeth of all gears of a two-, three-, or four-step cluster gear on a battery of "Red Ring" diagonal shaving machines set up in line, side by side. This arrangement permits a full view of the complete process by the operator.

Only one operator is needed to supply the magazine of the first machine with unshaved gears and

to remove the gears from the discharge chute of the final shaving machine. All work-handling between machines is done by automatic mechanical transfer mechanisms, and each cutting cycle is automatic. Although all machines are synchronized for multiple operation, each has individual control and can be used independently.

The principal elements of this simplified loader include a loading magazine with gravity feed, an intermediate feeder slide, and an inclined discharge chute. At the



Straight-line automatic loader applied to "Red Ring" gear-shaving machines, set up in line to shave the teeth of cluster gears

completion of the cutting cycle of the first machine, which shaves the first gear of a cluster, the cutter stops and the pneumatically actuated tailstock retracts to strip the shaved gear and place it on the unloading finger of the feeder slide. As this slide advances, it deposits the shaved gear in the discharge chute and simultaneously brings an unshaved gear from the magazine into mesh with the cutter. Immediately, the tailstock advances to engage the new gear, cutter rotation begins, and the feeder slide returns to its initial position, ready for the next cycle.

The gear deposited in the discharge chute of the first machine

is engaged by the fingers of the transfer mechanism and deposited in the magazine of the next machine, which shaves the second gear of the cluster. Thus, the gear is passed from one machine to the next until all gears of the cluster have been shaved.

The unloading chute of the last machine stores the completed gears until they can be removed by the operator. If this is not done, and the chute becomes completely filled, the shaving machine stops automatically until the chute is cleared. An automatic gage at the entrance to the feed magazine of the first machine prevents the inclusion of any over-size gears. 64

### Trane Evaporative Quenching Oil Coolers

An evaporative cooler designed to cool quenching oil in a closed system by means of the atmospheric evaporative principle is being manufactured by the Trane Co., La Crosse, Wis. The cooling unit consists basically of two centrifugal fans, a set of water sprays, a coil, and a spray water tank, arranged in that sequence from the top of the casing down.

In this type of evaporative cooler, the quenching oil flows through the tubes. The outside of each tube is constantly drenched with water by the sprays above

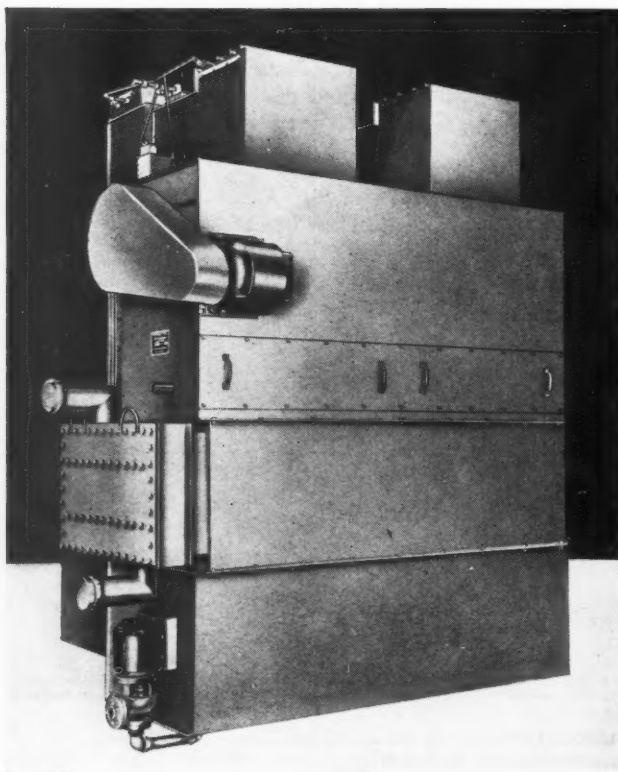
the coil. Heat from the liquid inside the tube flows through the tube wall to the spray water by conduction. As heat is added to the spray water, a small portion of it evaporates into the air. The heat necessary for this evaporation is obtained from the remaining spray water, thus cooling it. This evaporation of some of the spray water transfers heat to the air and increases its wet bulb temperature. Centrifugal type fans incorporated in the unit provide the forced air circulation required to carry away this heat. 65

### Front "Torkrail" Adapts "Torkarm" for Use on Multi-Spindle Drills

The "Torkarm," a unique work-holding device manufactured by the Torkarm Corporation, Minneapolis, Minn., to absorb torque on drill presses and tappers, is now provided with a front "Torkrail" unit which enables it to be moved from spindle to spindle down the front of an in-line multiple-spindle drill press. Either the work or a fixture can be placed on the work plate, the "Torkarm" attached directly to the fixture, or the fixture held by a special "Quic-Clamp." With either method, the work is free to "float" under the spindles, and yet is always controlled by the "Torkarm."

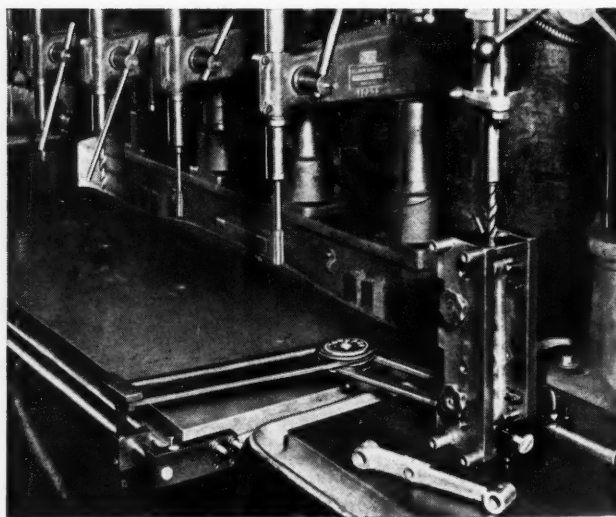
There is no limit to the number of holes that can be completed under each spindle, or to their position in the fixture, when the "Torkarm" is used. A work plate with "jig pins" or the "Quic-Clamp" facilitates the use of tumble jigs. By using extra saddles and "Torkarms," more than one job can be run on the same drill press at the same time.

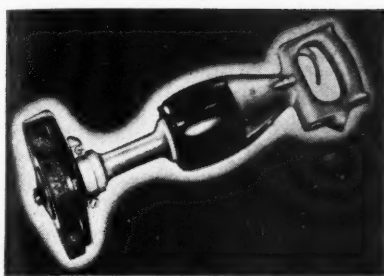
The front "Torkrail" unit is manufactured in two sizes—the Series No. 300 for work requiring up to 1 1/2 H. P., and the Series No. 500 designed for use on heavier work. 66



(Left) Evaporative quenching oil cooler of closed system design now being manufactured by the Trane Co.

(Below) "Torkarm" with new front "Torkrail" unit, applied to four-spindle drill press. With this equipment it is possible to use all four spindles of one press and to swing the fixture onto an adjoining drill press to complete fifth drilling operation





New air grinder with safety features recently announced by the Ingersoll-Rand Co.

### Ingersoll-Rand Air Grinder with Special Safety Features

The Ingersoll-Rand Co., New York City, has just announced an air grinder equipped with a safety device that is designed to prevent over-speed operation. This grinder is adapted for use in foundries, steel mills, and general manufacturing and metal-working plants where hand-grinding is required for snagging, trimming, smoothing, and similar work.

The new safety device consists of a motor governor for maintaining correct wheel speed and a built-in unit called the "over-speed safety coupling." In case of over-speed of the motor, due to governor wear, maladjustment, abuse, or dirty air, the safety coupling automatically uncouples the arbor and the grinding wheel.

Another safety feature of the grinder is a multiple exhaust system, which permits the operator to choose any one of four exhaust outlets, spaced 90 degrees apart, so that he can direct the exhaust away from the work and himself. Special muffling is said to so reduce the exhaust noise that ten of the new grinders make no more noise than one of the previous models.

The grinder has a grip type handle with enough space between the throttle lever and the back of the handle to permit a comfortable hand hold. This allows the grinder to be safely carried while connected to the air line. The new type rubber-faced throttle valve is unaffected by oil or moisture.

Other construction features provide 20 per cent more power than previous models, and at the same time reduce the weight. The grinder is available for 8-, 6-, or 5-inch wheels, running at respective motor speeds of 3100, 4100, and 4500 R.P.M. 67

### Niles Side-Head Vertical Boring and Turning Mill

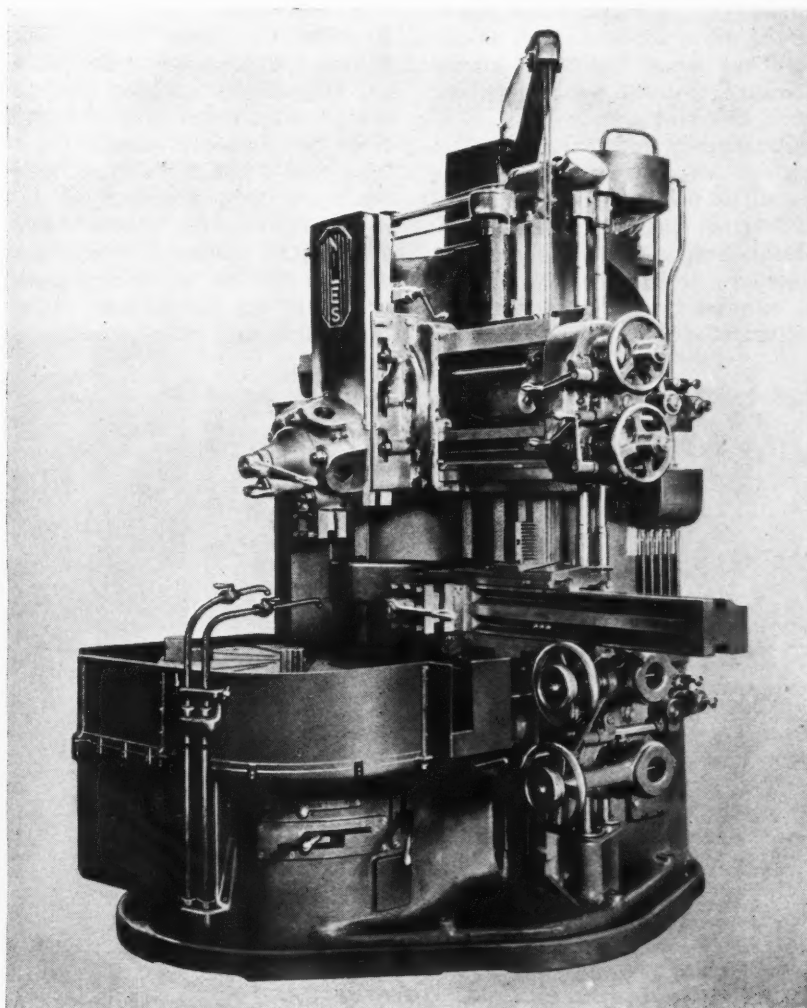
An improved 42-inch vertical boring and turning mill with side-head has just been announced by the Baldwin-Lima-Hamilton Corporation, Hamilton, Ohio. This machine has been modernized by providing increased table speeds and corresponding feed changes; by the use of anti-friction bearings in the table speed-change gear-box and table mounting; and by employing a higher powered drive from a 30-H.P. motor.

It is designed to combine the advantages of turret lathe, engine lathe, and vertical boring and turning mill, with independent or simultaneous engagement of down and cross feed or power traverse for both rail-head and side-head. Centralized and simplified controls for multiple tooling adapt the machine for job shop or quantity production.

Features contributing to greater accuracy include integrally cast

column and base, which increases rigidity; a three-track cross-rail, which assures accurate alignment between cross-rail and table in all positions of the rail; an elevating screw adjacent to the narrow guide, which prevents tilting and binding; and provision for compensating for wear of moving parts. A center stop which accurately locates the rail-head and maintains correct alignment between it and the center line of the table spindle is an important feature essential to accurate boring with double-head cutters and drilling and reaming.

The swing of the machine with side-head down is 50 inches, and the maximum distance from the table top to turret face is 48 inches. The vertical head has five faces, a slide travel of 28 inches, and can be swiveled 45 degrees to either side of the vertical position. The side-head has four faces,



Niles vertical side-head boring and turning mill, redesigned to give higher table speeds and increased power

a vertical travel of 35 inches, and a horizontal travel of 21 inches.

There are twelve table speeds ranging from 9 to 200 R.P.M. and sixteen feeds for either vertical

or side head of 0.003 to 0.520 inch per revolution of the table. The machine occupies a floor space of 8 feet 4 inches by 8 feet 10 inches, and is 10 feet 6 inches high. — 68

### Simplified Pressure-Control Mechanism for Marform Deep-Drawing Equipment

The Marform Division of the Loewy Construction Co., Inc., New York City, has developed a simplified pressure-control mechanism for use with Marform equipment. This mechanism, as shown in the illustration, consists of a flexible strip cam, which is readily adjusted by merely turning the friction locking adjustment knobs.

The developed profile on the strip cam determines the magnitude of the rubber-pad forming pressure as utilized by the Marform process of precision deep-drawing. In addition to the pressure control, the setting of the three sliding indicators determines the upper and lower limits of the draw depth, as well as the point at which intense forming pressure is built up for setting radii, shearing, etc.

Emergency and manual control buttons are also included on the panel, as well as pressure gages indicating the system oil and accumulator pressures. These controls are adjustable in a matter of minutes by merely setting the calibrated rods to predetermined

positions, as ascertained by the tool design department. Once such controls are set, the operation is fully automatic, and all that is required on the part of the operator is to place a blank in the machine, push a button, and then remove the drawn part, which is automatically stripped from the punch. — 69

### Bruning Low-Cost Copying Machine

Copies of drawings and printed matter used in all phases of business and industry can be produced on a new low-cost "Copyflex" machine announced by the Charles Bruning Co., New York City. This machine, known as the Model 20, is specially adapted for medium-volume production of prints from tracings, engineering drawings, and other large sized technical originals, and for copying large sized records, balance sheets, charts, and statistical statements and reports kept by the day, week, or month for production, inventory, sales, and cost control.

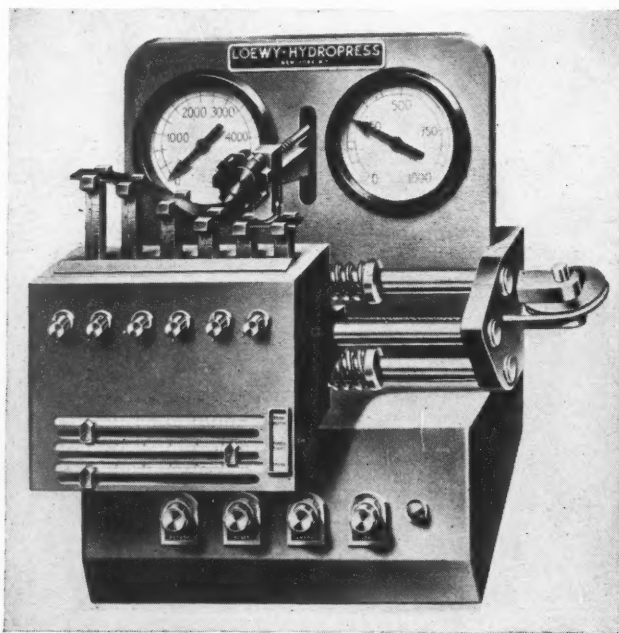
The machine has a 46-inch printing width, with exposure speeds up to 95 inches per minute. No installation work is required, it only being necessary to make connections with a 60-cycle, 115-volt, alternating-current electric line. Machines for 50- and 25-cycle current are also available.

Copies can be made on "Copyflex" sensitized paper, acetates, films, and cloths. The operator merely feeds the sensitized sheet into the machine with the translucent original to be copied. Copies are processed by the machine and stacked ready for use. — 70

### American Optical Goggles and Plastic Cover Plate for Welding Helmet

A rubber-frame goggle designed to provide a gas-tight seal is announced by the American Optical Co., Southbridge, Mass. This new AO701 goggle is constructed without any ventilation slots in the frame to prevent infiltration of air. When the goggle is perfectly fitted, a gas-tight seal results. The head band of the goggle enters slots in the outer goggle frame. The goggles can be obtained in combination with respirators, either permanently riveted together or separate.

A new plastic cover plate that provides greater protection for welding-helmet windows has also been announced by the company.



Marform pressure-control mechanism developed by the Loewy Construction Co., Inc.



Bruning "Copyflex" wide-model copying machine for drawings and business records



Rubber-frame goggles designed to provide gas-tight seal, made by American Optical Co.

This new plate is clear, hard, and almost colorless. It possesses a surface comparable in smoothness, luster, and chemical resistance to polished plate glass, although it is more resistant to pitting than glass. The plate will not discolor under ordinary welding conditions, and will not peel, crack, blister, or shrink in service. — 71

### "Microptic Auto-Collimator" for Precision Inspection Work

Important improvements in the Watts 18-inch "Microptic Auto-Collimator" have been announced by the Engis Equipment Co., Chicago, Ill., American distributor for Hilger and Watts, Ltd., London, England. This instrument is adapted for a wide range of gage and fixture inspection operations and for the testing of precision

mechanisms. Through the use of simple accessories, a large number of extremely accurate angular measurements can be made, which are readily converted into precise distance measurements.

The "Auto-Collimator" can be used to determine and check straightness, squareness, and inclinations to one-half second of arc (0.0000025 inch per inch of length). It operates upon the

principle that a beam of light reflected by a mirror is deflected if the mirror is tilted, and that the angle through which the reflected beam is turned is twice the angle to which the mirror is tilted. Through the micrometer eye-piece of the instrument, a reflected image of reference lines can be observed, by means of which the tilt is determined to a fraction of a second of arc. — 72

### Motch & Merryweather Cam-Controlled Automatic Forming Machine

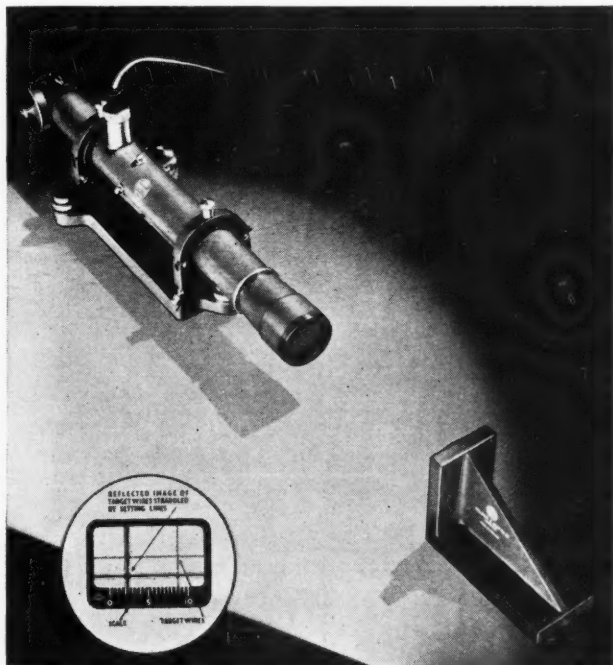
The Motch & Merryweather Machinery Co., Cleveland, Ohio, has recently added a new model to its line of cam-controlled automatic forming machines. The functions of this machine are mechanically controlled by one main camshaft. The machine illustrated is equipped to turn the outside diameter and chamfer one end of laminated silicon steel motor rotors. Different lengths of any one diameter rotor can be handled.

The forming machine cycle is as follows: Cam-actuated loading mandrels automatically enter the center hole of each piece and force it against the hardened drive spurs mounted on the face of each spindle while the magazine slides retract and reload. The tool-slide then descends rapidly to the operating position and feeds horizon-

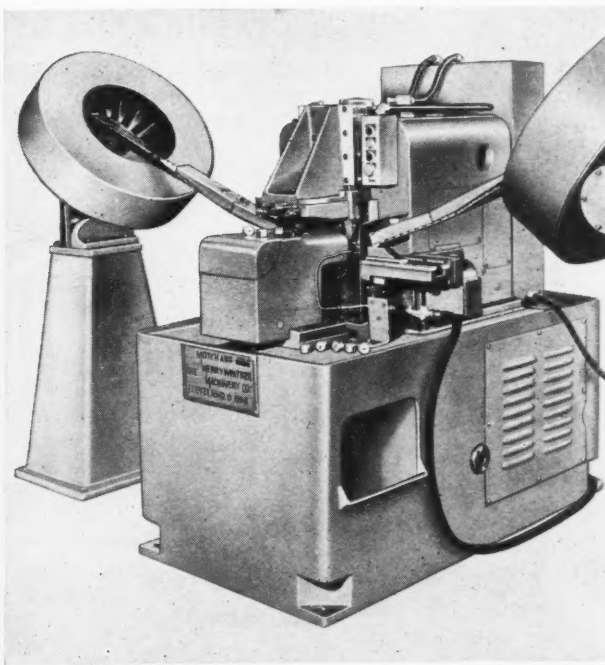
tally across the diameter of the work. It is then quickly withdrawn to the dwell position, where a second tool chamfers the trailing edge of the piece.

The cam-actuated loading mandrels are now withdrawn from the work-pieces, allowing them to fall into chutes which convey them by gravity to a tote box. Two more work-pieces are brought to the loading position by the magazine slides as the cycle is completed. Production is at the rate of 800 pieces per hour.

The machine can be furnished with hopper or magazine feed. When long pieces are to be formed and cut off, a hydraulically operated bar feed can be furnished. The main camshaft has its own drive motor, as has each of the two machine spindles. — 73



"Auto-Collimator" for precision inspection of gages, fixtures, and mechanisms, introduced into this country by Engis Equipment Co.



Cam-controlled automatic forming machine with hopper feed, recently brought out by the Motch & Merryweather Machinery Co.

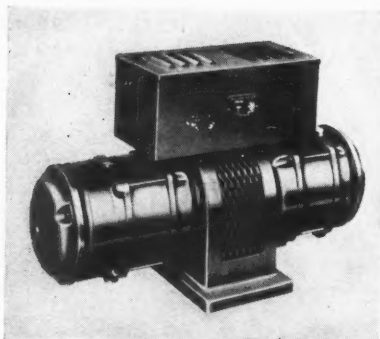


Fig. 1. Power unit of adjustable-speed motor system recently announced by Baldor Electric Co.

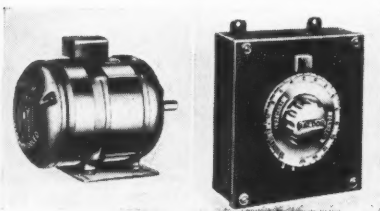


Fig. 2. (Left) Driving motor of Baldor adjustable-speed motor system. (Right) Controller used with power unit shown in Fig. 1

## Baldor Adjustable-Speed Motor System

The adjustable-speed motor system recently announced by the Baldor Electric Co., St. Louis, Mo., is designed for operation from polyphase or single-phase alternating-current circuits. It consists of three units—a motor-generator set, a controller, and a drive motor, as shown in the above illustrations, Figs. 1 and 2. These units can be mounted at any distance from each other and in any convenient position desired.

A single controller provides sixteen forward and sixteen reverse steps of speed adjustment of 150 R.P.M. each, up to a total of 2400 R.P.M., accompanied by full dynamic braking. If a finer speed adjustment than that provided by the single controller is required, a vernier rheostat can be connected in the circuit.

Each rotating unit is of the Baldor "Streamcooled" design. Glass insulation is utilized wherever practicable, to obtain compactness and reduce maintenance cost. Excitation is obtained by a full-wave rectifier of the Tungar type. Sizes range from 3/4 through 3 H.P. for operation from polyphase circuits, and 3/4 through 1 1/2 H.P. for operation from single-phase circuits. ....74

## Vernier Power Feed for DoAll Contour-matics

Improved power feed control has recently been applied to the Contour-matic hydraulically operated band tool machines built by the DoAll Company, Des Plaines, Ill. This new refinement gives the operator more sensitive control of the hydraulic table when band-sawing thick steel sections or when line-grinding or diamond-sawing vitreous and frangible materials or any of the various hardened alloys.

As shown in the accompanying close-up view of the Contour-matic control panel, the table in-feed knob has an added vernier control at the side. This enables the operator to start a cut with a feed rate that will prevent shock

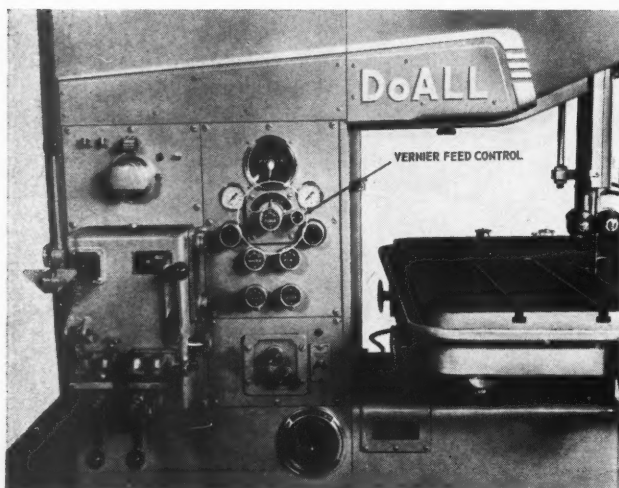
or damage to the band tool or the work-piece. The value of this close control is evident when it is realized that 200 pounds pressure is available for moving or feeding the table.

The other knobs on the centralized control panel employed to save time in making set-ups and adjustments while the machine is running control the following functions hydraulically: Adjust band tool tension; position guide post; tilt table; determine direction and speed of 16-inch table stroke; adjust work feed pressure; and adjust the tool speed, which is variable between 40 and 10,000 feet per minute. The hydraulic brakes of this machine are automatically set on both wheels if the band breaks or the drive motor is stopped. ....75

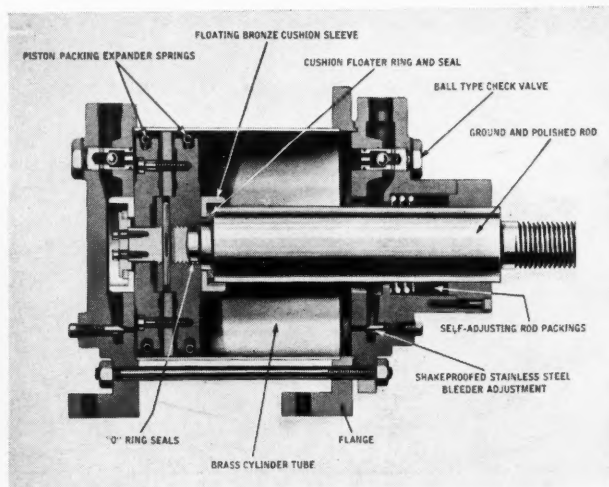
## Hanna Low-Pressure Cylinders

The Hanna Engineering Works, Chicago, Ill., has brought out a complete line of low-pressure cylinders which operate by air, oil, or water. Unusual features of these cylinders include a cork floater ring which facilitates cushion alignment with the head and insures a seal during cushioning; spring-backed chevron rod packings which are self-adjusting for correct compression; and flange design which permits removal of the front head without disturbing the mounting.

Cylinders in this line are designed for operating pressures up to 110 pounds per square inch, and with minor modifications, for

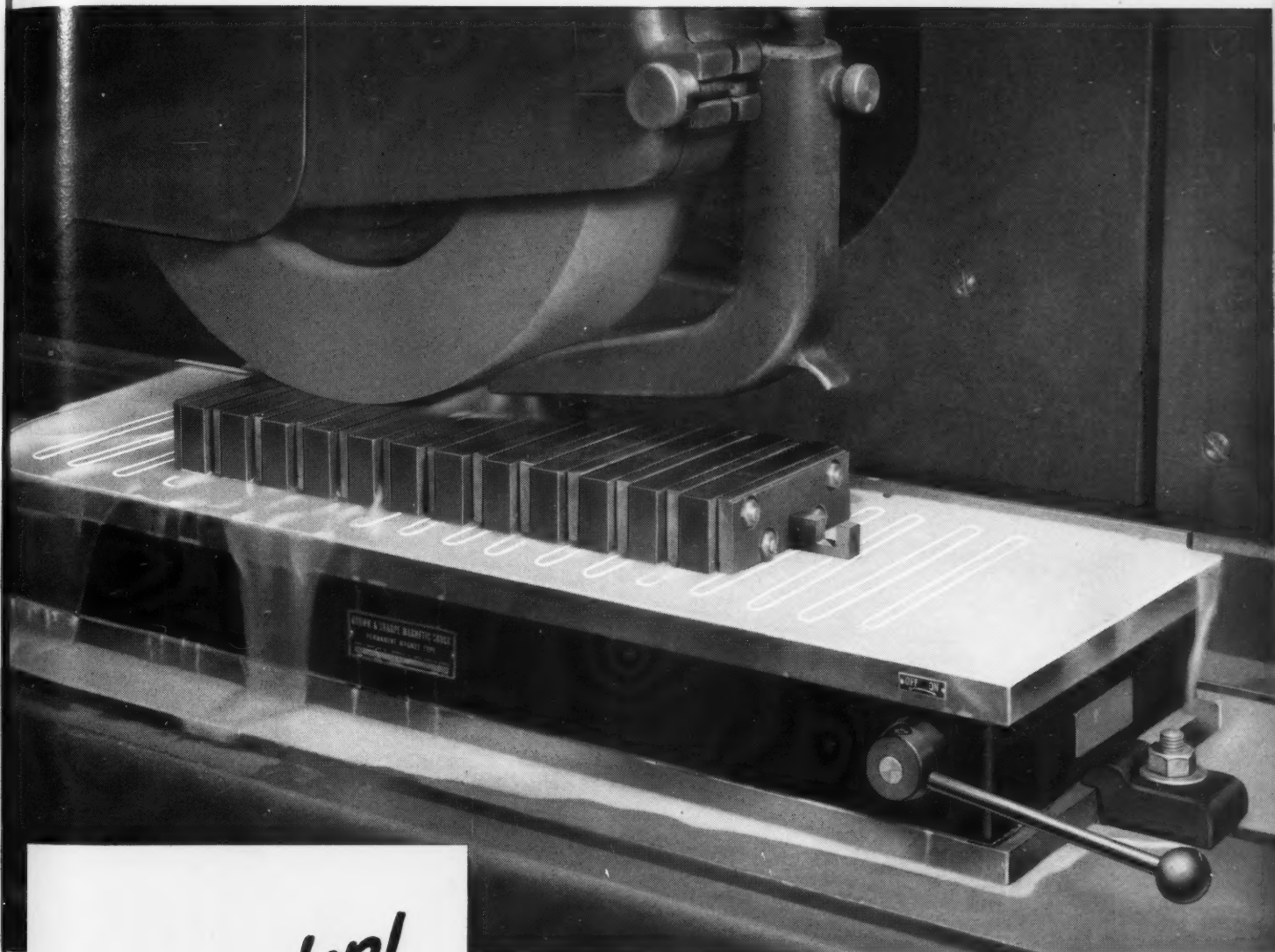


DoAll Contour-matic hydraulically operated band tool machine equipped with improved power feed control



Cross-section of typical cylinder of low-pressure line manufactured by the Hanna Engineering Works

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Complete line includes Rectangular Models for grinding, inspecting, light machining; and Rotary Models for light lathe work, cylindrical and face grinding. Rectangular Models available in 8 sizes from  $2\frac{7}{16}$ " x  $5\frac{1}{4}$ " to  $12\frac{1}{8}$ " x 36"; Rotary Models in 5", 7", and 9" diameters. For sale only in the United States and its territories. Write for catalog.



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**BROWN & SHARPE No. 10N Cutter and Tool Grinding Machine**  
with UNIVERSAL or PLAIN Equipment

**T**ODAY'S HEAVIER DEMANDS on your production tools make it more important than ever to keep all the machines in your shop producing — and producing at top efficiency.

The Brown & Sharpe No. 10N Cutter and Tool Grinding Machine is designed especially to help prevent those toolroom bottlenecks that rob your shop of scheduled production. Simplicity, flexibility, and convenient controls permit sharpen-

ing of cutters and tools in minimum time — with keen, accurate edges for efficient cutting.

The No. 10N is available with Universal equipment, for complete cutter and tool sharpening, plus light cylindrical, internal and surface grinding jobs — or with Plain equipment, where the requirements are for cutter and tool sharpening only. The same basic design is common to both. Write for complete illustrated bulletin.



**No. 10N CUTTER AND TOOL  
GRINDING MACHINE WITH  
UNIVERSAL EQUIPMENT**  
Centers swing 10" dia.; takes  
20" length; 3 wheel speeds  
3000 to 4500 R.P.M.

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The economies of using steel stock accurately pre-ground to size are now available to you on an even broader scale. Brown & Sharpe offers a choice of oil or water hardening types in 16 different thicknesses from 1/64" to 1" ... a total of 145 sizes. What's more, in eight thicknesses up to and including 3/16", a single type of stock now serves for either oil or water hardening ... a convenience available only in the Brown & Sharpe line.

Further conveniences of Brown & Sharpe Ground Flat Stock include continuous repeat markings on every piece, for instant identification; and a protective envelope in distinctive color. Write for folder.



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higher pressures, depending on the cylinder diameter and operating medium. Standard models permit the selection of a cylinder to meet practically any mounting requirement. .... 76

### "Quik-Lok" Clamp Designed for Use on "Di-Acro" Benders

The O'Neil-Irwin Mfg. Co., Lake City, Minn., has just brought out a new accessory for its "Di-Acro" benders known as the "Quik-Lok" clamp. This clamp, shown in Fig. 1, is available for the Nos. 2 and 3 "Di-Acro" benders now in use. It can be readily bolted to the bender base, as seen in Fig. 2. The latter illustration shows the new "Quik-Lok" clamp in use on a No. 2 "Di-Acro" bender.

This quick acting clamp is es-

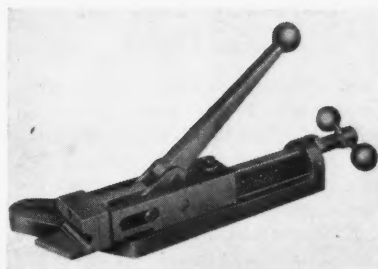


Fig. 1. "Quik-Lok" clamp for "Di-Acro" benders, made by the O'Neil-Irwin Mfg. Co.

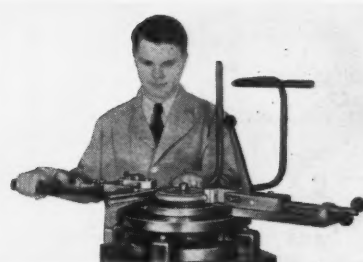


Fig. 2. "Di-Acro" bender equipped with new "Quik-Lok" clamp

pecially useful in bending tubing, angle, channel, and extrusion materials, as it locks the work securely in place during the forming operation and assures the production of an accurately formed bend. The wide opening jaws of the clamp are designed especially to allow easy removal of the completely formed part.

The clamp will accommodate all

materials which ordinarily come within the range of the two sizes of "Di-Acro" benders, and can be readily adjusted for any bending radius up to a maximum of 9 inches. The field of usefulness of both the No. 2 and No. 3 "Di-Acro" hand-operated benders has thus been considerably broadened by the development of the new clamp. .... 77

### Lake Erie Press for Drawing Cartridge Cases

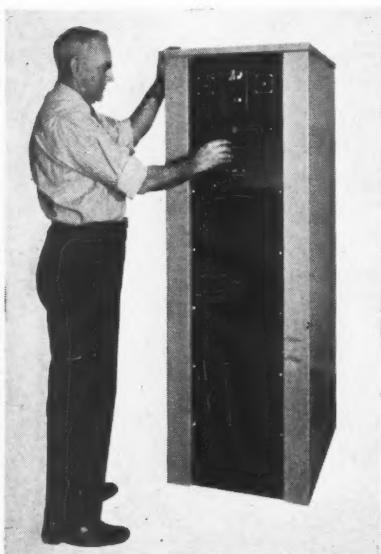
Press of 200-ton capacity designed and manufactured by the Lake Erie Engineering Corporation, Buffalo, N. Y., for the first drawing operation on 105-millimeter cartridge cases produced from cold-drawn steel. This press has a bed area of 30 by 30 inches, a daylight opening of 66 inches, and a stroke of 48 inches. It stands 22 feet above the floor, and is driven by a 125-H.P. motor. .... 78





### Starrett Micrometer with Rounded Anvil

Micrometer with rounded anvil introduced by the L. S. Starrett Co., Athol, Mass. Developed for use in measuring the wall thickness of bearings, tubing, and cylinders having walls up to 1 inch thick and of any size down to 5/8 inch inside diameter. Since the anvil contact surface is rounded, the wall thickness of curved-surface work can be accurately measured in thousandths of an inch. A complete table of decimal equivalents is stamped on the micrometer thimble. Accuracy is maintained by simple sleeve adjustment. ....79



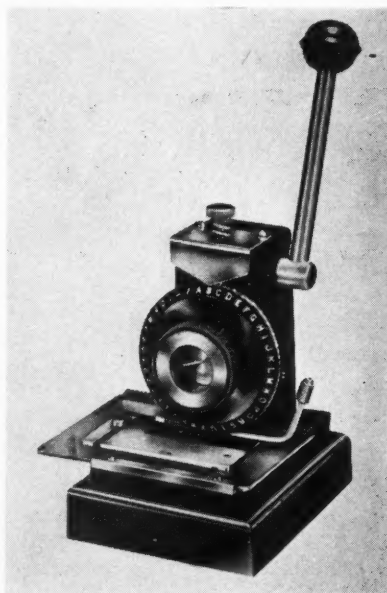
penetration with twist drills having the new carbide tips is said to be double that of untipped drills, and their life three or four times greater. Standard twist drill tips of Grade 883 carbide for drilling non-ferrous materials are also carried in stock in twenty-three sizes. .... 81

### Clearview Nameplate Press

Low-priced manually operated press designed to stamp neat, uniform characters on nameplates for machines. The press has fully automatic letter spacing; hardened-steel dial; and adjustable depth control. It accommodates plates up to 2 by 3 inches. Manufactured by the Clearview Co., New York City. ..82

### General Electric Redesigned Single-Phase "Inductrol"

Redesigned single-phase "Inductrol" now being made in standard ratings of 9.6 to 24 KVA by the General Electric Co., Schenectady, N. Y. This addition to the G-E line of induction voltage regulators is designed to widen the field of application in which uniform voltage control can be obtained economically with small regulators. The new units are available for single-phase circuits of 600 volts and less in capacities up to 1000 amperes. With standard controls, the single-phase "Inductrols" can be used for secondary circuit regulation where lighting and power are supplied from the same lines. They can also be used in calibrating and testing meters, instruments, and transformers, and for operating resistance and induction furnaces. .... 80

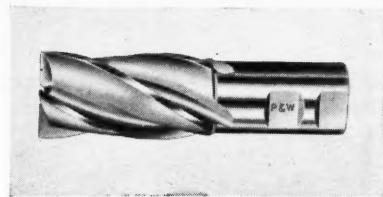
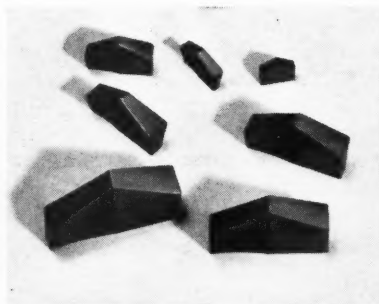


### Kennametal Face Milling Cutter

Simplified axial face mill brought out by Kennametal Inc., Latrobe, Pa. The new design has solid Kennametal blades and structural features said to make possible the cutting of cast iron at table speeds of 60 to 70 inches per minute. This cutter is suitable for both general-purpose and high continuous production milling. It has only four parts—body, blades, wedges, and nuts. Wedges and screws remain assembled to the cutter body at all times, thus reducing the possibility of lost parts. The blades are of the heavy solid wedged-in type which requires no hammers or special tools for tightening. They are available in two styles—one for cutting to a square shoulder and the other for cutting to a 45-degree corner. Blades and wedges

### Carboloy Tips for Twist Drills

Carboloy blanks for twist drill tips from a standardized line now carried in stock by the Carboloy Department, General Electric Co., Detroit, Mich. These blanks were brought out to meet the requirements of recent developments in the technique of drilling cast iron. The standard tips of this line are of Grade 44A carbide, and range in size from 1/4 to 1 inch nominal diameter, by steps of 1/16 inch. The rate of drill



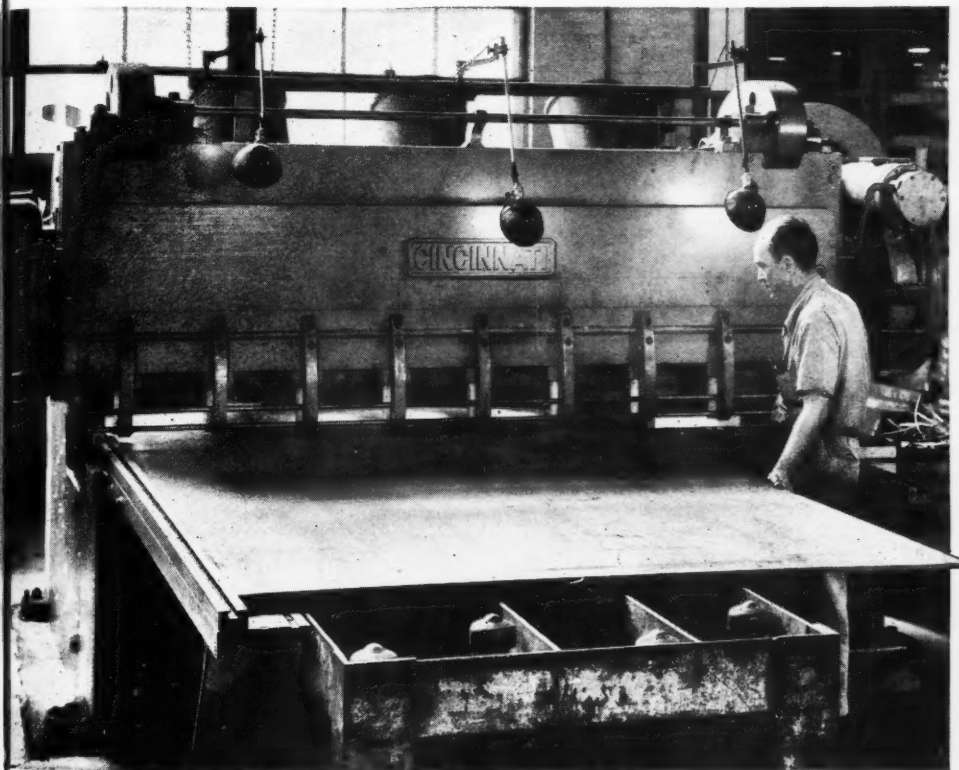
### Pratt & Whitney Heavy-Duty End-Mill

Heavy-duty end-mill with 2-inch diameter shank and fast-cutting helix design, recently added to the line of "Hi-Helix" end-mills made by the Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford, Conn. This ruggedly designed cutter has ample chip clearance for taking heavy end milling cuts. It is suitable for use on the Kellering machine, die-sinking, and similar work. Shanks are of the Weldon type and have two set-screw flats to insure a positive drive. Diameters range from 2 to 2 1/2 inches. Made of high-speed steel with right-hand cut and right-hand spiral flutes. ....83



• BAKER-RAULANG COMPANY, says:

## a Cincinnati Shear brought these results



- |   |                        |
|---|------------------------|
| 1 | lower costs            |
| 2 | stable deliveries      |
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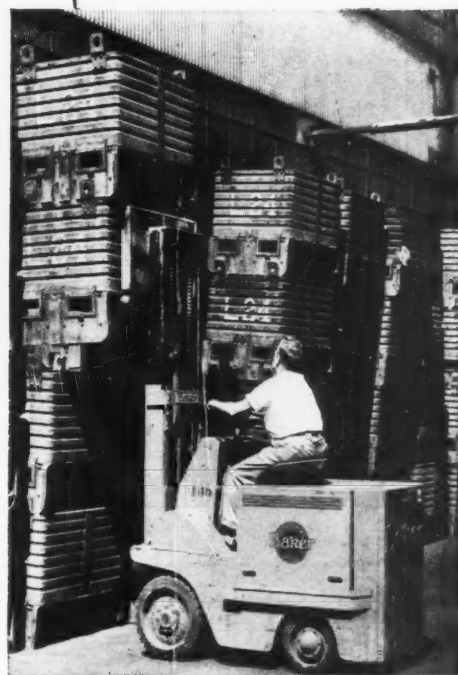
With the installation of this Cincinnati Shear, a do-it-yourself program replaced dependence on outside sources at the Baker-Raulang Company, manufacturers of industrial trucks.

Sheets of any required size are now sheared without delay and are always ready for assembly when needed. This results in a smoother, controlled manufacturing schedule, reduced inventory and, at the same time, improved deliveries.

The accurate performance of Cincinnati Shears reduces shearing costs—savings in subsequent fabricating operations result from better fits.

If you use sheared sheets, a Cincinnati Shear in your own shop may save you money.

Write for Catalog S-5—covering the very complete line of Cincinnati All-Steel Shears.



*Photos courtesy Baker-Raulang Company, Cleveland, Ohio*



### THE CINCINNATI SHAPER CO.

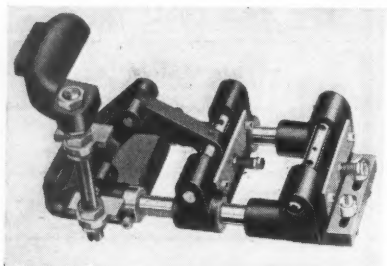
CINCINNATI 25, OHIO U.S.A.

SHAPERS · SHEARS · BRAKES

are interchangeable in any size cutter body of the same type. These Style MF Kennamills are made in seven cutting diameters ranging from 6 to 18 inches, either right- or left-hand. ....84

### Producto Automatic Feed for Stamping Presses

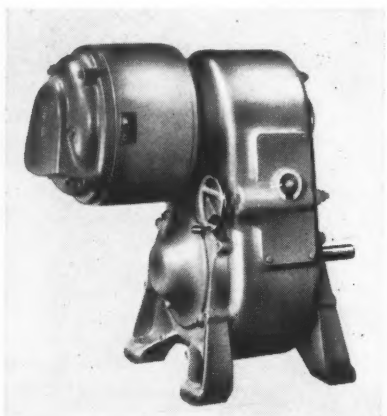
New positive-action automatic feed, called the "Surefeed," developed by the Producto Machine Co., Bridgeport, Conn. This feeding device is simple in design, ruggedly constructed, easy to mount on any ordinary press, and can be quickly set up for the required feed



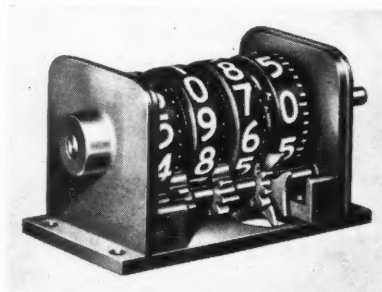
length. Stock up to 2 inches wide and 0.045 inch thick can be readily advanced by this feed, which is operated by the movement of punch-holder. ....85

### Sterling "Speed-Trol" Drive

New "Speed-Trol" electric power drive designed by Sterling Electric Motors, Inc., Los Angeles, Calif., to meet the demand for variable-speed drives of 20- and 25-H.P. ratings in the metal-working, plastics, and other industries. The unit illustrated is a "Drip-Proof" model, designed to prevent liquids or any foreign material from falling into the motor. Outstanding features include positive adjustment of pulleys; infinite speed variation; and accurate control of speed of varying loads. Drives of 20- and 25-H.P. ratings will also be available in "Splash-Proof" and totally enclosed fan-cooled models, with built-in reduction gears for the lower

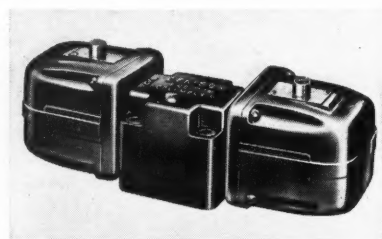


speed ranges. All models can be supplied with manual control or with electric or mechanical remote control. ....86



### Veeder-Root High-Speed Counter

Mechanical counting device announced by Veeder-Root, Inc., Hartford, Conn. This patented counter, incorporating a high-speed Geneva transfer mechanism, has been designed to meet requirements for higher speeds. It has figures more than 1/4 inch high to provide easy readability. The drive-shaft speed is rated at 1500 R.P.M., which gives 15,000 counts per minute with a standard ten-digit unit wheel. The counter is of the non-reset type, adding when the drive-shaft is rotated in one direction, and subtracting when the drive-shaft is reversed. It can be made in any figure capacity desired. ....87

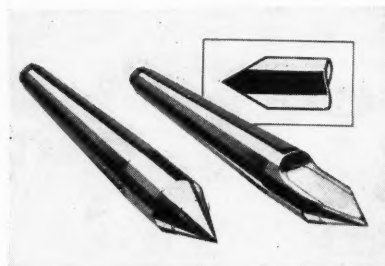


### Denison Hydraulic Valve Designed to Eliminate Spool Sticking

Four-way solenoid valve developed by the Denison Engineering Co., Columbus, Ohio, to eliminate spool sticking in high-pressure hydraulic circuits used for long cycling operations. This pilot-operated valve utilizes system pressures to move the spool, solenoids being employed only to operate small internal pilot valves. The result is said to be smooth, quick, and positive spool action under operating pressures up to 5000 pounds per square inch. The spool always moves at the same rate of speed, regardless of operating pressures. The valve is available in 3/4- and 1 1/2-inch sizes, in both single and double solenoid types, and with provision for either external or internal pilot connections. Eight types of spools provide for eight port arrangements. 88

### Gorham Wear- and Abrasion-Resistant Lathe Centers

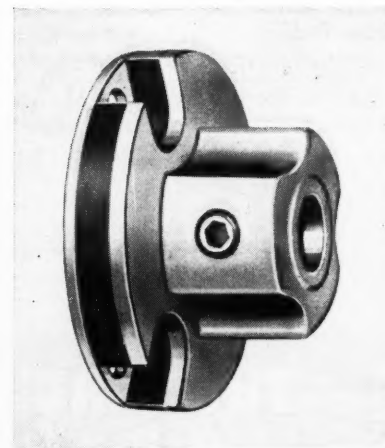
Wear- and abrasion-resistant centers available from Gorham Tool Co., Detroit, Mich. The wear- and abrasion-resistant material "M-40-U," developed by the manufacturer, forms a deep core (see inset) which is induction-brazed into the steel shank of the center, after which the entire center is finish-ground. Thus the wear-resistant material is supported by the tough shank steel throughout the life of the center. These centers require only a



clean-up grind when wear finally occurs. As seen in the illustration, standard centers and half-centers are available. Both styles are made with Morse, Jarno, or Brown & Sharpe taper shanks, in lengths from 3 5/8 through 12 3/4 inches. ....89

### Lord Bonded-Neoprene Fan Hub

Bonded-neoprene hub developed by the Lord Mfg. Co., Erie, Pa., to reduce fan and motor noises in window type air-conditioner. The new hub consists of a stamped aluminum washer and a zinc die-casting, between which is bonded neoprene of proper stiffness to insure fan stability and maximum vibration isolation. Three rivets through the aluminum washer serve to secure the hub to the fan, and a single socket-head set-screw in the die-casting attaches it to the motor-shaft. ....90





# Between Grinds

By E. S. Salichs

## Medicine Man

The Young American Business Conference has been formed by sixty small new corporations with J. S. Finger, president of the Corrulux Corporation, Houston, Tex., as national chairman. Objective of the Conference is "to modify the Excess Profits Tax Law which does not permit normal growth of the small new concern." Finger's job is to get the pulse of the nation, prescribe a remedy.

## Calking Good Story

The Diamond Calk Horse Shoe Co. of Duluth, Minn., recently purchased our book "Ordnance Production Methods." Their interest must be extending beyond the horse's hoof.

## Optics in the Office

"If you really want ideal work for your eyes, trade in your swivel chair for a saddle and the life of a cowboy out in the wide-open spaces"—is the advice of Dr. Franklin M. Foote, executive director of the National Society

for the Prevention of Blindness. Realizing that we can't take to the ranch pronto with a bronco, Dr. Foote made some sage suggestions on preventing eye strain, one being to keep articles with highly-polished surfaces off your desk since light reflected from them can cause tired eyes.

## In Tune with the Turn of the Century

One of our readers shipped us a copy of June, 1900, *MACHINERY*—A Practical Journal for the Machine Shop—which we enjoyed thumbing through, since there's something about a magazine that has been on the town for half a century that a bound volume such as we can always refer to, doesn't have. The Paris Exposition was featured (tickets of admission 1/2 franc, or 10 cents, but 8 to 10 A.M. and 6 to 10 P.M., two tickets demanded per person); the Adams Express Co.'s automobile wagon for heavy duty was discussed, including the "speed-changing device which should emulate the peculiarity of the horse's muscular system";

and a letter to the Editor on engineering difficulties of the South African War began: "The layman cannot easily realize the vast amount of material as to food and ammunition demanded by an army in the field." Another item humorously quoted a reporter describing a western shop: "One of the new machines is a 12-foot open-side iron planer. It works with the utmost regularity, planing off thick iron shavings as easily as a carpenter's plane turns up the curling pine shavings that little children love to wear in imitation of an old maid's curls."

## A Whether Condition

The Air Development Force Laboratory now operates an environmental laboratory consisting of twenty stainless steel-lined cabinets in which weather from any part of the globe can be reproduced. We are wondering whether the lab acknowledges its work with "Any similarity between our man-made weather and Mother Nature's is purely coincidental."

**GREETING G. T. FERGUSON**—subscriber to *MACHINERY* for over fifty years—new member of our Fifty-Year Club. Born in Minooka, Ill., the son of a blacksmith and wheelwright, he worked after school hours in the smithy. At the age of eighteen, however, our young blacksmith hammered at the gates of industry, obligingly opened to him as an apprentice machinist by the Bates Machine Co. of



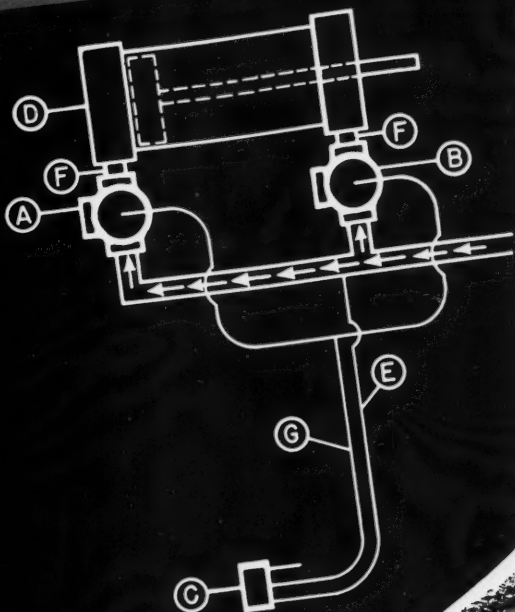
Joliet. This was 1898 and the year Mr. Ferguson first subscribed to *MACHINERY*. (He tells us that he has read every issue since.) About ten years later, he began tool and die work as a model maker, then became a tool and machine designer. Now a resident of Baraboo, Wis., Mr. Ferguson spends his leisure time making labor-saving devices, and is also a bit of a botanist.







# How to Boost Production with *new* Method of Mounting Ross Valves



- ★ **Faster Machine Speeds**
- ★ **Less Air Consumption**
- ★ **Economical Installation**
- ★ **Easier Operation**

Close-coupling of valve to cylinder! That's the story behind the remarkable success of the *new* Ross In-Line Master Valve.

Users claim several important advantages. By placing the master valves (A & B) at the cylinder (D), air supply and exhaust are speeded up appreciably. This in turn permits faster movement of the cylinder piston and materially increases production.

At the same time, the close coupling means that two lengths of large diameter piping between valve and cylinder—pipes continually filled and exhausted with non-productive air—are replaced

by two short connecting pipes (F). The resultant saving in air with every movement of the piston considerably reduces operating costs.

Operation is by a small, conveniently located 3-way pilot valve (C). It is supplied through tubing (E) and connected to the master valves by tubing (G). It may be mechanically, manually or electrically controlled. Hand or foot operation is greatly facilitated by the use of the smaller, more easily actuated pilot model.

The complete story of possible advantages in *your* production will be gladly furnished without obligation. Ask for Bulletin No. 302.

*Ask Ross for Any  
Air Control Information*

Ross makes valves only — hundreds of types and sizes. Take advantage of the experience gained in over a quarter century of concentration on control and application of air power!

**ROSS OPERATING VALVE COMPANY**



120 E. GOLDEN GATE AVE., DETROIT 3, MICHIGAN

# News

## OF THE INDUSTRY

### Illinois

LEONARD J. FREEMAN has been appointed district field engineer in the territories of eastern Iowa and northern Illinois (with the exception of Chicago) for the Denison Engineering Co., Columbus, Ohio, manufacturer of Multipresses. He was formerly direct factory representative and field engineer for the company in the Chicago area. His headquarters will be at the Chicago office, 11047 S. Hale Ave.

SKILSAW, INC., Chicago, Ill., manufacturer of portable power tools, announces that its San Francisco branch has moved to 295 S. Van Ness Ave., San Francisco 3, Calif., and the Cleveland branch to 3038 Payne Ave., Cleveland 14, Ohio. The new locations provide larger quarters, which are equipped with complete facilities for servicing and demonstrating Skill tools.

CLEARING MACHINE CORPORATION, Chicago, Ill., has purchased a 27-acre tract of land in Joliet, Ill., and started the construction of a modern factory building, which is expected to be in operation early next year. It is planned to equip the new plant for the smaller and lighter operations. About 32,000 square feet of working area will be provided by the new facilities.

SIMONDS SAW & STEEL Co. and SIMONDS ABRASIVE Co. have moved their Chicago branch office from 127 S. Green St. to 3323 W. Addison St. The new location affords 40,000 square feet of floor space for the combined office, shop, and warehouse.

CHARLES B. COBUN has joined the Chicago district sales office of the Heppenstall Co., Pittsburgh, Pa., manufacturer of steel forgings, as assistant to J. C. PATTON, JR., district representative. Mr. Cobun was associated with the United States Steel Co. for many years.

ROBERT E. MITCHELL has been promoted from district sales manager to the position of field sales manager of the Cummins Portable Tool Division, Cummins-Chicago Corporation, Chicago, Ill.

BRADLEY BARTLETT has been appointed chief engineer of Kling Bros. Engineering Works, Chicago, Ill.

### Indiana

GENERAL ELECTRIC Co., Schenectady, N. Y., announces the following changes in its Fractional-Horsepower Motor Engineering Divisions at Fort Wayne, Ind.: J. HERBERT BEHM has been named assistant to the manager of engineering on special assignments; LEE R. BEARD will serve as division engineer of the Alternating-Current Motor Engineering Division; RAY D. JONES becomes division engineer of the Development Engineering Division; and I. E. ROSS holds a similar position in the Direct-Current and Specialty Motor Engineering Division.

CARBOLLOY DEPARTMENT OF GENERAL ELECTRIC Co., Detroit, Mich., has appointed TOOLS & ABRASIVE, INC., 1510-12 Oxford St., Fort Wayne 5, Ind., as authorized distributor in the Fort Wayne, Ind., area. Headquarters and sales rooms will be maintained in Fort Wayne for Carbolloy tools, blanks, and other products.

### Michigan

CAPTAIN ELLSWORTH E. ROTH, USN, RET., has been appointed assistant to the works manager, Defense Division, of the Ingersoll Products Division, Borg-Warner Corporation, Kalamazoo, Mich. Captain Roth's experience as chief of the naval continuing board for development of the LVT will be of especial value to the Ingersoll Products Division, which is now designing and building an amphibian vehicle for military use.

A. WILLIAM TILDER has been appointed vice-president and general manager of the Acromatic Tool Co., Oak Park, Mich., manufacturer of high-speed steel and carbide-tipped cutting tools. Mr. Tilder has been in the cutting tool field for twenty-five years, most recently being associated with the Whitman & Barnes Division of the United Drill & Tool Corporation, where he was manager of the Carbide-Tipped Tools and Hercules Interchangeable Punch Division.

METAL CARBIDES CORPORATION, Youngstown, Ohio, has opened a new sales office, warehouse, and service plant at 20485 Van Dyke, Detroit, Mich., where a complete stock of Talide carbide products will be carried. A. B. CHRISTMAN is in charge.

### New Jersey and Connecticut

EWALT MAURUSHAT has recently been appointed sales engineer for the New England district by Hyatt Bearings Division of the General Motors Corporation, Harrison, N. J. Mr. Maurushat, who has been with the Division since 1937, will be located at Worcester, Mass., and will devote the greater part of his time to the textile industry. He is replacing FRANK U. NAUGHTON, JR., who has become manager of Hyatt's Eastern Sales Division at the company's headquarters in Harrison.

GROOV-PIN CORPORATION has moved its plant and general offices from Union City, N. J., into larger quarters at 1119-1133 Hendricks Causeway, Ridgefield, N. J.

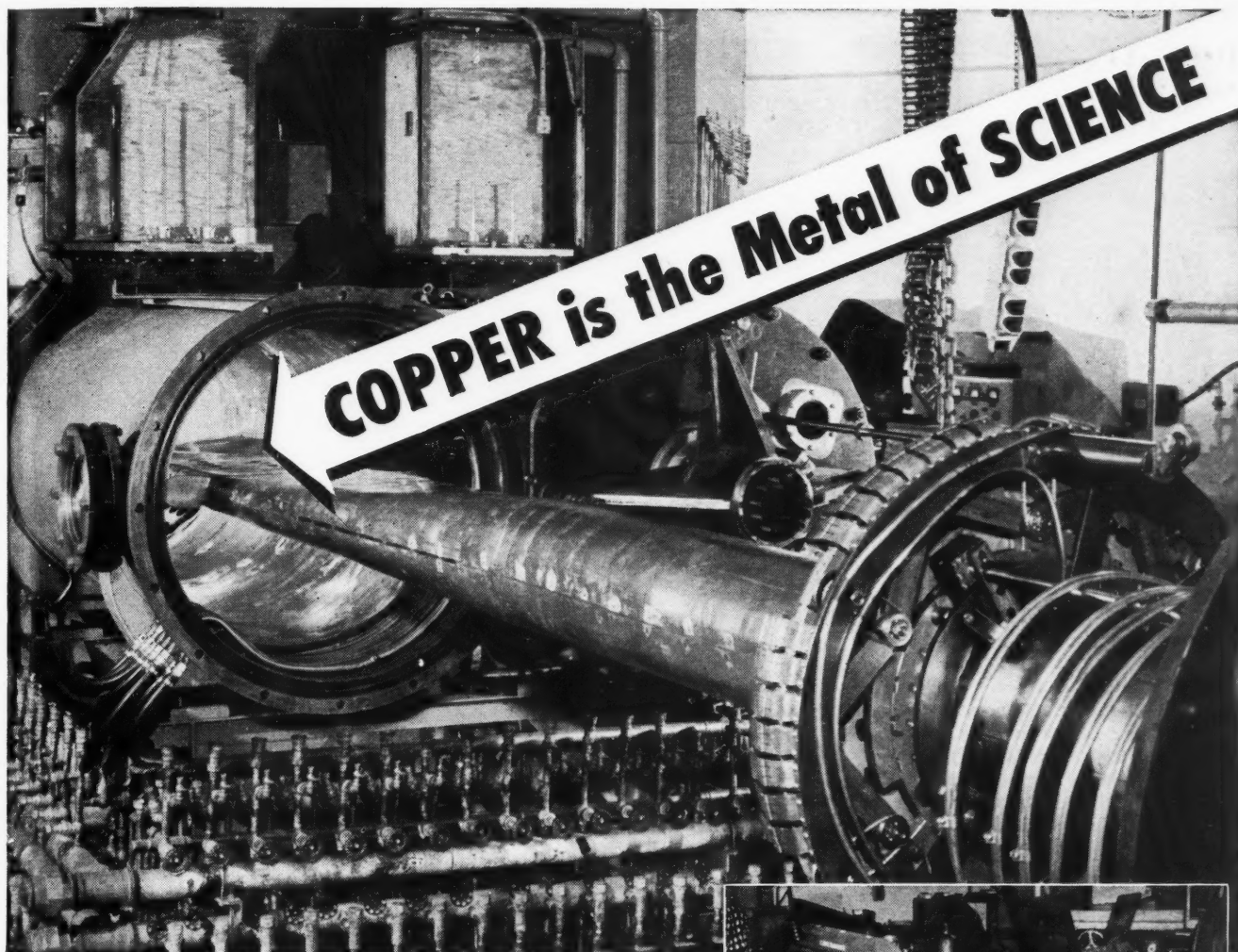
HOGLUND ENGINEERING & MFG. Co., maker of Magni-Form wheel-dressers, has just moved into new buildings having 60,000 square feet of manufacturing space at Berkeley Heights, N. J.

LEO MARTIN and JAMES W. HULL have joined the staff of the Flexible Tubing Corporation, Guilford, Conn. Mr. Martin's position is that of machine design engineer, in charge of the company's machine development and design laboratory. Mr. Hull is chief of the chemical laboratory and development section, and will also direct the setting up of quality controls in the company's new production lines.

### New York

LYON-RAYMOND CORPORATION, Greene, N. Y., manufacturer of electric industrial trucks and hydraulic elevating equipment, announces that the firm name has been changed to the RAYMOND CORPORATION, effective September 1. The concern was founded in 1840 as the Lyon Iron Works, and in 1922, was reorganized as the Lyon-Raymond Corporation, at which time the company entered the material-handling field.

GENERAL ELECTRIC Co., Schenectady, N. Y., announces the following changes in personnel: WILLIAM E. SAUPE has been appointed operation manager and WILL PRUESSMAN manager of manufacturing of the Schenectady Steam Turbine and Generator Divisions. DR. LOUIS T. RADER has

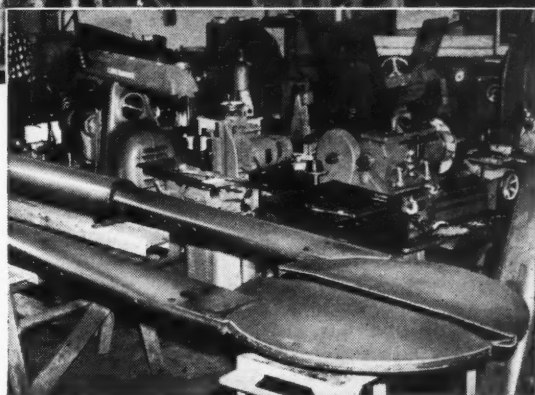


*D and D Stem being inserted in Cyclotron; made of Revere Electrolytic high-conductivity copper, hot rolled and annealed,  $\frac{1}{8}$ " thick. Note also large number of bronze valves to control flow of cooling water through brass pipe.*

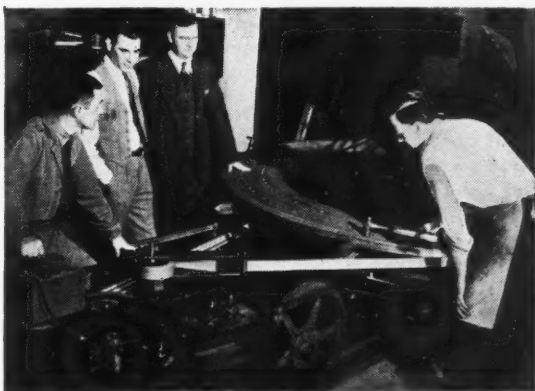
● For many years Revere has been saying that "Copper is the metal of invention." It has high electrical and heat conductivity, excellent resistance to corrosion, is easily fabricated and formed, so that it is attractive to designers and inventors, as well as to manufacturers. Now we say it is also "The metal of science," because it is so essential to the operation of most scientific devices.

The pictures on this page illustrate some of its uses in a cyclotron, built by and for the Nuclear Physics Laboratory of the University of Washington in Seattle. The instrument was designed and constructed so far as possible by University personnel, who were completely successful in working copper into the most complicated shapes.

Revere collaborated on the project in various ways, and furnished copper bar, sheet, rod and tube to the University's high specifications. Remember that Revere will be glad to consult with you on your problems concerning copper and copper alloys, and aluminum alloys.



*Photo taken in the University of Washington shop during fabrication of the two Ds and D Stems.*



*Seven miles of Revere copper bus bar were wound into great coils for the cyclotron electromagnet. The University built the winding machine itself, and wound the coils in its own shop. The special Revere bar is soft temper, free from scale, with rounded edges.*

**REVERE** 150<sup>th</sup> YEAR OF SERVICE TO AMERICA  
**COPPER AND BRASS INCORPORATED**

Founded by Paul Revere in 1801  
 230 Park Avenue, New York 17, N. Y.

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. — Sales Offices in Principal Cities, Distributors Everywhere

SEE "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY



(Left) William E. Saupe, operation manager of General Electric Steam Turbine and Generator Divisions. (Right) Will Pruessman, manager of manufacturing of the same divisions

R. F. Tomlinson, newly appointed general sales manager of the A. B. Farquhar Co.

been named manager of engineering of the company's Control Divisions, and HARRY L. PALMER has been made his assistant. BENJAMIN COOPER becomes division engineer of the Electronics and Regulator Engineering Division. JAMES H. GOSS, formerly manager of engineering of the Control Divisions has been appointed staff assistant to the general manager of the Small Apparatus Divisions, and will make his headquarters at Lynn, Mass.

CARL HIRSCHMANN Co., 30 Park Ave., Manhasset, N. Y., has been appointed exclusive United States representative for KARL HULLER, of Germany, manufacturer of precision tapping machines, and for METEOR, LTD., Zurich, Switzerland, manufacturer of machines and devices for grinding twist drills and taps.

GEORGE I. ZIDERS has been appointed industrial plant engineer for the Sanderson-Halcomb Works of the Crucible Steel Co. of America, in Syracuse, N. Y. Mr. Ziders has been associated with the Donora Steel & Wire Works of the American Steel & Wire Co. for the last ten years.

DON W. PATTERSON Co., 2016 Rand Bldg., Buffalo, N. Y., has been appointed exclusive sales representative in western New York State of the Watson-Stillman Co., Roselle, N. J., manufacturer of hydraulic machinery and equipment.

## Ohio

H. L. HENRY has been made divisional sales representative for northern Ohio of the Hydraulic Machinery Division, Watson-Stillman Co., Roselle, N. J. Mr. Henry, who previously

represented the company in western New York State, will make his headquarters in Akron, Ohio.

E. W. RISTAU has been appointed general manager of the Ohlen-Bishop Mfg. Co., Columbus, Ohio, manufacturer of saws. The Ohlen-Bishop concern was recently acquired by the Rockwell Mfg. Co., Pittsburgh, Pa., as a subsidiary, to augment the products of the Delta Power Tool Division of the company.

C. FRED WATKINS was recently appointed sales manager of Heller Brothers Co., Newark, N. J. He will make his headquarters at Newcomerstown, Ohio. Before joining the Heller organization, Mr. Watkins was general sales manager of the American Swiss File & Tool Co., of Newark, N. J.

ALBERT R. PFELTZ, JR., has been made assistant manager of sales in the Cincinnati district sales office of the U. S. Steel Corporation. He has been assistant to the manager of sales in the New York district office since 1947.

DON S. URQUHART has been appointed product engineer for the Wel-Met Co., Kent, Ohio, manufacturer of self-lubricating bearings and structural parts made of metal powders.

## Pennsylvania

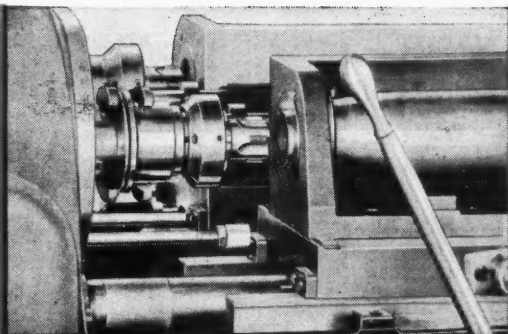
R. F. TOMLINSON has been appointed general sales manager for all divisions of the A. B. Farquhar Co., York, Pa. Mr. Tomlinson has been associated with the company since 1931, when the Portable Ma-

chinery Co. was acquired. He was midwestern branch manager of the latter company, and continued to hold that position after the merger. In 1947, he was transferred to York and took over the responsibilities of sales manager of the Conveyor Division. In his new capacity, he will supervise the sales activities of the farm machinery, conveyor, hydraulic press, and special machinery divisions of the company.

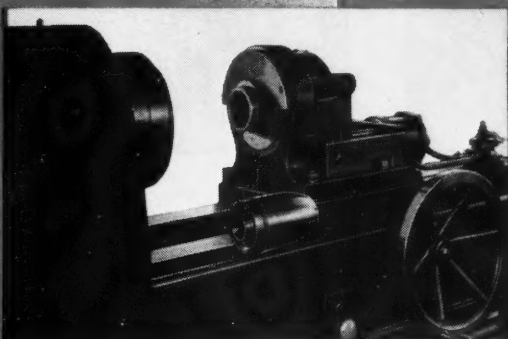
SKF INDUSTRIES, INC., Philadelphia, Pa., manufacturer of ball and roller bearings, announces that construction has started on a \$10,000,000 plant expansion program. The program includes additions to the company's two Philadelphia plants and to the Shippensburg, Pa., plant. The new facilities will enable the company to make a greater contribution to the defense effort, in addition to supplying bearings essential to the civilian economy.

WILLIAM W. WELLBORN has been appointed research engineer of the Carbide Research and Development Department of the Firth Sterling Steel & Carbide Corporation, Pittsburgh, Pa. Mr. Wellborn has been associated for the last five years with the Los Alamos, AEC, Scientific Laboratories of the University of California, where he designed and equipped the present powder metallurgical laboratories.

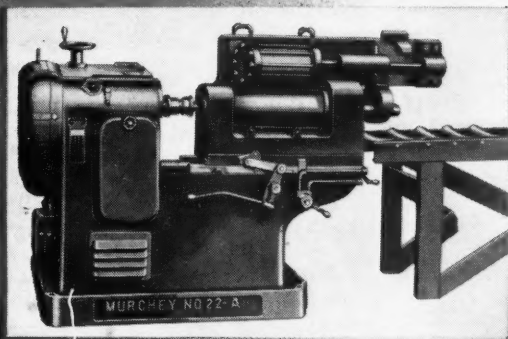
HENDLEY BLACKMON, assistant manager of engineering association activities for the Westinghouse Electric Corporation, Pittsburgh, Pa., has been promoted to the position of manager of these activities, succeeding FRANK THORNTON, JR., who recently retired.



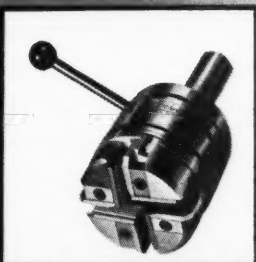
Topping Two 75 MM Shells on a Murchey Double Head Shell Tapper using "L" Taps



Murchey Thread Mill for Gun Barrels, Rocket Tubes and Breech Blocks



Topping the Nose of a 105 MM Shell



Murchey Self-Opening Die Head and Collapsible Tap



*Lower Cost per Thread*



THESE  
**Murchey Veterans**  
again in active service  
**ON DEFENSE  
PRODUCTION**

These Murchey Threading Machines are ideally engineered for threading the components of guns and ammunition at maximum production rates and minimum costs. Their service record during the last war was outstanding. Now they are going back into active service on the same products.

When used with Murchey self-opening die heads and collapsible taps the combination affords several important advantages—

1. Quickest job changeover.
2. More threads between chaser regrinds.
3. Longer chaser and tool service life.
4. Equalized chaser wear.
5. Less tool inventory.
6. Lower tool replacement costs.
7. Quicker tool adjustment.
8. Just one minute to replace chasers.

If you are getting ready for defense work involving threading, get the suggestions of a Murchey Division engineer. He may be able to save you valuable time.

**MURCHEY DIVISION  
OF THE**

**MURCHEY**

**SHEFFIELD CORPORATION**  
DAYTON 1, OHIO, U.S.A.

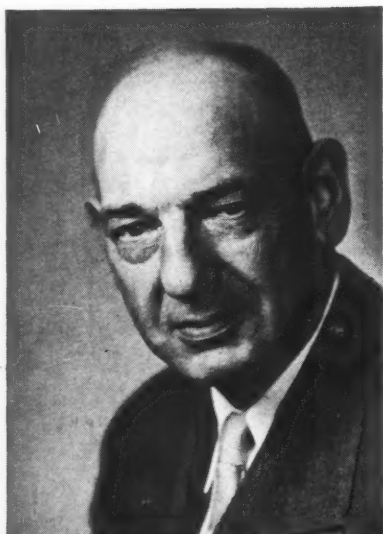
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(Left to Right) Wallace M. Loos, manager of mill products for the Carpenter Steel Co.; Harold A. Brossman, manager of stainless steel sales; and Howard M. Goodman, manager of alloy steel sales

WALLACE M. LOOS, formerly manager of stainless steel sales for the Carpenter Steel Co., Reading, Pa., was recently made manager of mill products, in which capacity he will serve as liaison between the sales department and the mill scheduling unit. HAROLD A. BROSSMAN assumes Mr. Loos's previous position, while HOWARD M. GOODMAN, who has been serving as assistant manager of stainless steel sales, becomes manager of alloy steel sales in Mr. Brossman's place. ROBERT F. KOCH has been promoted to the position of assistant manager of stainless steel sales. He had been in the stainless sales department since 1936.

JOHN AUTH, SR., recently celebrated his fiftieth year of association with



Graule Studios

John Auth, Sr., who recently completed his fiftieth year with the Vanadium-Alloys Colonial Steel Division

the Colonial Steel Division of the Vanadium-Alloys Steel Co., Latrobe, Pa.

ROBERT M. MERK has been appointed chief engineer of the Sharon Steel Corporation, Sharon, Pa. For the last four years, Mr. Merk has been superintendent of the galvanizing and panel department of the H. H. Robertson Co., Ambridge, Pa.

HOWARD E. HORNICKEL has been advanced from assistant works superintendent to works superintendent of the American Steel & Wire Co.'s Donora, Pa., Zinc Works, succeeding M. M. NEALE who retired on July 31.

GEORGE BREZA has been made chief engineer of the Mackintosh-Hemphill Co., Pittsburgh, Pa. Mr. Breza had been assistant chief engineer since 1937, when he joined the company.

## Texas

HAROLD B. RIDGLEY has been named assistant superintendent in charge of all tool manufacturing and tool engineering for the Texas Engineering & Mfg. Co., Inc., Dallas, Tex., and PARIS F. YOUNG has been made assistant superintendent of machine shop and spar milling and finishing.

WALL COLMONOY CORPORATION, Detroit, Mich., has opened a new office and warehouse at 5815 Clinton Drive, Houston 1, Tex., with HENRY L. HOWARD as manager. Mr. Howard has been associated with the welding industry for a number of years.

MORSE TWIST DRILL & MACHINE Co., New Bedford, Mass., recently opened a cutting tool warehouse in Houston, Tex., located at 5003 Navigation Blvd.

## Wisconsin and Missouri

J. E. POLHEMUS has been appointed representative for southern and eastern Wisconsin by the Detroit Broach Co., Detroit, Mich. His headquarters will be at 833 E. Kilbourn Ave., Milwaukee 2, Wis.

H. C. ENDE, JR., has been appointed Milwaukee branch manager for the Crucible Steel Co. of America, Pittsburgh, Pa. He was formerly sales and service engineer in the Milwaukee territory.

JOHN E. RENNER has been appointed general sales manager of the Lincoln Engineering Co., St. Louis, Mo., manufacturer of lubrication equipment. Mr. Renner was formerly sales manager of the automotive division.

\* \* \*

## National Association of Aluminum Distributors

Several months ago, the National Association of Aluminum Distributors was organized to deal with the problems arising out of the rapid growth of the aluminum industry that started just after World War II. Officers of the newly formed group, recently announced, are as follows: President, Harry L. Edgcomb, Jr., Edgcomb Steel Corporation, Hillside, N. J.; vice-presidents, W. W. Doney, T. E. Conklin Brass and Copper Co., New York City, and T. Stenson White, Nottingham Steel Co., Cleveland, Ohio; and treasurer, Ralph W. Shaw, Jr., A. R. Purdy Co., Lyndhurst, N. J. Raymond L. Collier, for the last twenty-two years connected with iron and steel foundry trade associations, has been appointed executive secretary.

# Obituaries

## William H. Nichols

William H. Nichols, president of the W. H. Nichols Co., a firm he founded fifty years ago, died August 9 at his home in Waltham, Mass., two days after his seventy-eighth birthday. Noted as a pioneer inventor in New England, he invented the Zenith rayon pump, the Gerotor pump, and the Nichols hand miller. His particular interests and hobbies included early machine tools, watch-making machinery, and antique clocks and watches.

Mr. Nichols was born on August 7, 1873, in Hamilton, Ontario, Canada. He undertook his first business venture at the age of sixteen—the operation of a bicycle building and repair shop. Later he won fame as a bicycle racer, establishing the world's record for the quarter-mile sprint.

He served his apprenticeship as a toolmaker at the Pratt & Whitney plant, later working in the Stanley Works, the Veeder Corporation, and the American Watch Tool Co. His first real shop was started in the cellar of his home in 1902, and after several moves and expansions, he established the present shop at 48 Woerd Ave., Waltham. During World War I, the plant turned out much essential war material for the famous Liberty airplane engine. In the second World War, his firm was awarded five Army-Navy "E" Awards for excellence in quality and production on many types of intricate parts for aircraft equipment.

Mr. Nichols received the National Association of Manufacturers "Pioneer Award" as one of twenty-six pioneer inventors in the New England states. He was a member of the Newcomen Society of Engineers and



William H. Nichols

the New England Live Steamers, an association of men interested in model railroads and steam-driven locomotives.

Surviving are his wife, two daughters, and two sons—W. Hart Nichols and Arthur A. Nichols—who were partners with him in the firm.

## Alfred G. York

Alfred G. York, director and vice-president of the Watson-Stillman Co., Roselle, N. J., died on July 22 at his home in Elizabeth, N. J. Shortly after joining the Watson-Stillman Co. in 1918, he became assistant treasurer, a position he held until his promotion as assistant to the president, in which capacity he started and developed the Distributor Products Division.

In 1941, he was elected vice-president and general sales manager of



Alfred G. York

the company, and in 1945 he became a member of the board of directors, at which time he took full charge of the Division he had organized.

Mr. York was a member of the Society of the Plastics Industry and the American Petroleum Institute. He was on the National Board for the Standardization of Fittings, and was also a member of the Manufacturers Standardization Society of the Valve and Fitting Industry.

## Robert Mawson

Robert Mawson, industrial engineer and contributor of technical articles to *MACHINERY* for many years, died on July 7, at the age of seventy-three years in Providence, R. I., after a brief illness. Mr. Mawson was born in England and educated at the Bradford Technical College and Bradford Mechanics Institute, Yorkshire.

Coming to the United States as a



Robert Mawson

young man, he began his career as machinist and toolmaker, and then was associated with the George S. May Co., Chicago, Ill., as industrial engineer and with the Trane Co., La Crosse, Wis., as factory manager. During World War II, Mr. Mawson acted as industrial specialist on the War Production Board; since then he had been an industrial consultant in Providence. From 1925 to the present time, outstanding articles written by Mr. Mawson have appeared in the Tool Engineering Ideas and Ingenious Mechanisms departments of *MACHINERY*. His wife survives him.

## Edward L. Zapp

Edward L. Zapp, chief metallurgist of the Tube Reducing Corporation, Wallington, N. J., died suddenly of a heart attack on August 5. Mr. Zapp had been with the corporation since 1943, and before that had been associated with Henry Disston & Sons, Inc., and with the Hyatt Roller Bearing Corporation.

With the latter company, he served as chief chemist and chief metallurgist during the years 1917 to 1937. He was an active member of the New Jersey Chapter of the American Society for Metals, and was elected a director for the three-year period 1950 to 1952.

VICTOR E. FRANCIS, a contributor to *MACHINERY* of articles relative to gearing, died of heart disease on July 15 at the age of twenty-nine years. Mr. Francis received his mechanical engineering degree from the College of the City of New York, and studied gear design at Wayne University. He had been associated with the National Broach & Machine Co., Detroit, Mich., and was a member of the Society of Automotive Engineers and the Industrial Mathematics Society.

## Coming Events

SEPTEMBER 10-15—Third annual NATIONAL INDUSTRIAL ENGINEERING CONFERENCE at Michigan State College, East Lansing, Mich.

SEPTEMBER 26-28—Fall meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at the Hotel Radisson, Minneapolis, Minn. Executive Secretary, C. E. Davies, 29 W. 39th St., New York 18, N. Y.

OCTOBER 1-2—Twenty-seventh annual meeting of the AMERICAN MACHINE TOOL DISTRIBUTOR'S ASSOCIATION at the Haddon Hall Hotel, Atlantic City, N. J. Executive Secretary, Thomas A. Fernley, Jr., 1900 Arch St., Philadelphia 3, Pa.

OCTOBER 3-5—National meeting of the PRESSED METAL INSTITUTE at the Drake Hotel in Chicago, Ill. Further information is available from the Pressed Metal Institute, 13210 Shaker Square, Cleveland 20, Ohio.

OCTOBER 4-5—Thirty-third annual meeting of the American Ordnance Association at the Netherland-Plaza Hotel, Cincinnati, Ohio (October 4) and at the Wright-Patterson Air Force Base, Dayton, Ohio (October 5). Further information can be obtained from the American Ordnance Association, Mills Bldg., Washington 6, D. C.

OCTOBER 8-12—THIRTY-NINTH NATIONAL SAFETY CONGRESS AND EXPOSITION in Chicago, Ill. For further information, write R. L. Forney, general secretary, National Safety Council, 425 N. Michigan Ave., Chicago, Ill.

OCTOBER 15-19—Thirty-third annual METAL SHOW and NATIONAL METAL CONGRESS at Detroit, Mich. Sponsored by the American Society for Metals; American Welding Society; Metals Branch, American Institute of Mining and Metallurgical Engineers; and Society for Non-Destructive Testing. Further information can be obtained from W. H. Eisenman, managing director, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

OCTOBER 15-19—FIRST WORLD METALLURGICAL CONGRESS in Detroit, Mich. Sponsored by the American Society for Metals, and to be held concurrently with the annual National Metal Congress and Exposition. For further information, address William H. Eisenman, managing director, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

OCTOBER 22-24—Thirty-third annual meeting of the AMERICAN STANDARDS ASSOCIATION at the Waldorf-Astoria, New York City, in conjunction with the second annual meeting of the NATIONAL STANDARDIZATION CONFERENCE. Managing Director, American Standards Association, Vice-Admiral George F. Hussey, Jr., 70 E. 45th St., New York 17, N. Y.

OCTOBER 22-24—Seventh annual ELECTRONICS CONFERENCE at the Edgewater Beach Hotel in Chicago, Ill. Publicity committee chairman, J. W. Armsey, Illinois Institute of Technology, Chicago 16, Ill.

OCTOBER 29-31—Semi-annual meeting of the AMERICAN GEAR MANUFACTURERS ASSOCIATION at the Edgewater Beach Hotel in Chicago. Executive secretary, Newbold C. Goin, Empire Building, Pittsburgh 22, Pa.

NOVEMBER 1-2—Fifteenth annual TIME AND MOTION STUDY AND MANAGEMENT CLINIC at the Sheraton Hotel in Chicago, Ill. Sponsored by the Industrial Management Society. Further information can be obtained by addressing the Society at 35 E. Wacker Drive, Chicago 1, Ill.

NOVEMBER 19-20—Fifty-second annual convention of the NATIONAL METAL TRADES ASSOCIATION (originally scheduled for September 26-28) at the Palmer House in Chicago, Ill. Further information can be obtained from Homer D. Sayre, Commissioner, 122 S. Michigan Ave., Chicago 3, Ill.

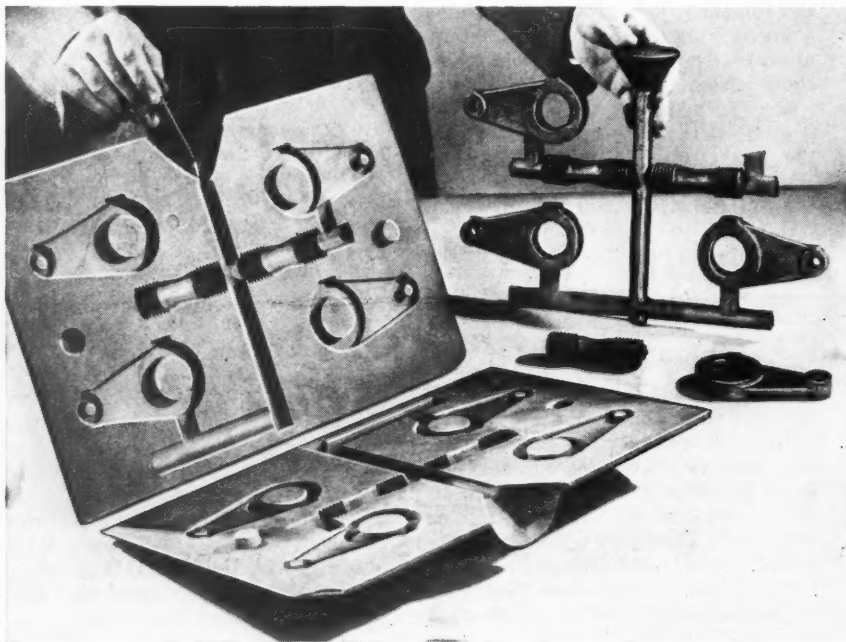
JANUARY 14-17, 1952—PLANT MAINTENANCE SHOW and PLANT MAINTENANCE CONFERENCE at Convention Hall in Philadelphia, Pa. Further information can be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York City.

FEBRUARY 9-MARCH 24, 1952—INTERNATIONAL INDUSTRIAL MACHINERY EXPOSITION in Delhi, India. Further information can be obtained from Consulate General of India, 3 E. 64th St., New York 21, N. Y.

MARCH 11-14, 1952—Fifth NATIONAL PLASTICS EXPOSITION, sponsored by the Society of the Plastics Industry, Inc., to be held at Convention Hall, Philadelphia, Pa. Further information can be obtained from Langdon P. Williams, director of public relations, 67 W. 44th St., New York, N. Y.

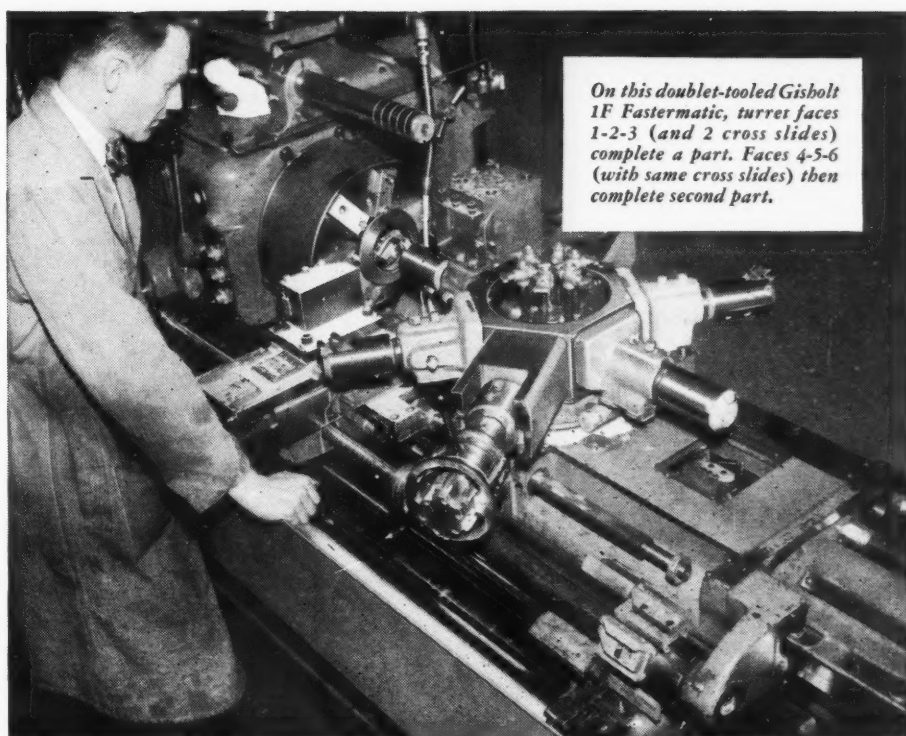
\* \* \*

If all the steel made in the World last year was divided among all the people on earth, each would get about 172 pounds, or 24 pounds more than could have been supplied in 1947.



From 30 to 40 per cent of the normal machining time is saved on the production of Meehanite machine parts cast by the new Croning Process. This process employs thin, shell-like single-use molds, made of sand bonded with Bakelite phenolic resins. The mixture of sand and resins is applied in a thin coating to the surface of a heated metal pattern, then baked hard to form half of a mold. Clamped together, the two halves of the mold are placed in a flask, surrounded by steel shot or other suitable bedding material, and the metal is cast. The smooth surfaces of the molds produce castings to tolerances of 0.002 to 0.003 inch, drastically reducing the work necessary to finish the piece.

# HOW DUPLICATE TOOLING... AND A FASTERMATIC...



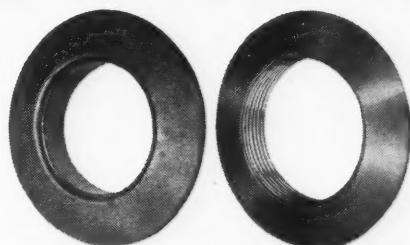
On this double-tooled Gisholt 1F Fastermatic, turret faces 1-2-3 (and 2 cross slides) complete a part. Faces 4-5-6 (with same cross slides) then complete second part.

# doubled production!

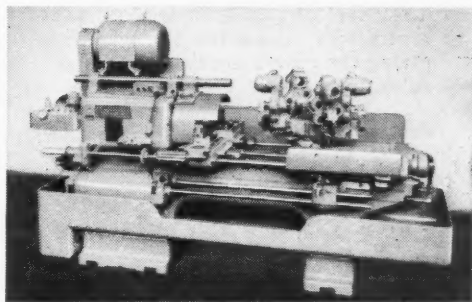
The time *and* unit cost for machining these cast iron pulley flanges were cut in half when the Fastermatic with double tooling took over the job.

Just three turret faces were needed to complete the machining and threading on each part. Therefore, tooling is repeated on the other three turret faces so that *two* parts are finished with each revolution of the turret. Production is doubled over the old method . . . time lag is cut to a minimum . . . there's twice the time between tool changes.

This smart setup illustrates one of the many ways Fastermatic Automatic Turret Lathes give you greater efficiency and lower costs on a broad range of jobs. And one operator can usually handle two or more machines. Ask for the facts.

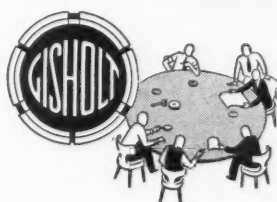


Floor-to-floor time for these pulley flanges is down to 1.75 minutes. Duplicate tools and collapsing taps on the turret rough and finish the bore, chamfer and cut threads. Front and rear slides shave the angle and form the radius on the O.D.



Gisholt 1F Fastermatic Automatic Turret Lathe

**GISHOLT MACHINE COMPANY**  
Madison 10, Wisconsin



THE GISHOLT ROUND TABLE represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

MACHINERY, September, 1951—243

## New Books and Publications

**GETTING MILITARY WORK.** By Walter Lord. 177 pages, 8 1/4 by 10 3/4 inches. Published by Business Reports, Inc., 225 W. 34th St., New York 1, N. Y. Price, \$12.50.

Military equipment requirements are shifting so rapidly these days that many opportunities are opening up for companies who wish to obtain defense contracts. It is, of course, highly important to know how to go about obtaining such work. This policy manual provides a working guide to the study that must be made. It is intended to help manufacturers analyze what the mobilization program calls for and determine to what extent their regular products can be fitted into the requirements. Suggestions are given for converting a plant from civilian to defense production, and the importance of proper timing in entering this field is emphasized.

Several chapters are devoted to explaining the best techniques for getting current business; how to sell facilities for sub-contract purposes; and how to pool sales and production efforts with other firms in the same manufacturing line. There is also a chapter on bidding, which includes a detailed form of bid for government business, completely filled in. The value of a manufacturer's representative in obtaining contracts is pointed out, and suggestions are given for insuring best results in using a representative.

Appendixes to the book include lists of military production planning offices; purchasing offices of the various departments of the Army and the items purchased by each; Navy buying offices and requirements; official list of Air Force requirements; Air Force bases that purchase locally; foreign government purchasing agencies; commerce department field offices; typical questionnaires for sub-contractors; and a list of documents giving the government's procurement rules, special laws, regulations, etc.

**SIMPLIFIED MECHANICS AND STRENGTH OF MATERIALS.** By Harry Parker. 275 pages, 5 by 8 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, \$4.

Written for use as a textbook in courses in mechanics and strength of materials, as well as for use by practical men interested in mechanics and construction, this book presents the fundamental principles dealing with the action of forces on bodies and their resulting stresses. The treatment is elementary, suitable for those who have had limited preparation. A working knowledge of algebra and arithmetic is sufficient to

enable the student to comprehend the mathematics involved in this volume.

One of the most important features of the book is a description of a large number of typical problems encountered in practice, together with a detailed explanation of their solution. This is followed by problems to be solved by the student. Such tables as are needed by the designers of structural members—for example, allowable stresses, properties of sections, etc.—are included.

The eighteen chapters treat of the following subjects: Mechanics and Strength of Materials; Forces; Forces Acting on Bodies; Moments of Forces; Stresses and Deformations; Properties of Sections; Shearing Stresses in Beams; Bending Moments in Beams; Continuous and Restrained Beams; Deflection of Beams; Bending Stresses, Design of Beams; Built-Up Beams of Two Materials; Columns; Rivets and Welds; Torsional Stress and Shafts; Stresses in Pipes and Tanks; Reinforced Concrete; and Retaining Walls and Dams.

**FUEL OIL MANUAL.** By P. F. Schmidt. 160 pages, 6 by 9 inches; Fabrikoid-bound. Published by THE INDUSTRIAL PRESS, 148 Lafayette St., New York 13, N. Y. Price, \$3.50, plus 40 cents postage for Canadian or overseas copies.

Those who buy, use, or sell fuel oil for building heating, power generation, marine applications, heat-treating, or other industrial processes will find this new Fuel Oil Manual of value. The author is chief chemist of the Allied Oil Co., Inc., Cleveland, Ohio, and the information presented is based on years of actual experience in "trouble shooting."

Complete data is given on the properties of fuel oil; possibilities and limitations of each grade of oil; methods that can be used to assure uniform quality and efficient combustion; and how to get the maximum value from each fuel oil dollar. Under "Troubles and Remedies" are listed twenty-two of the common fuel oil troubles, their symptoms, and the remedy to employ in each case.

The text, which includes thirty-four tables, is divided into twenty-four chapters covering the chemistry of petroleum; petroleum refining processes; grades and types of fuel oils; gravity; heat of combustion; viscosity; water and sediment; carbon, ash, and salt residue; flash and fire points; pour point; sulphur; color; distillation; preheating of oils; sampling storage tanks; stability of fuel oils; fuel-oil treatments; reclaimed fuel oils; blending of oils; transportation and storage; fuel oil specifications; and causes of troubles.

**DIE-CASTING INDUSTRY SAFETY MANUAL.** 44 pages, 9 1/2 by 11 1/2 inches. Published by the American Die Casting Institute, Inc., 366 Madison Ave., New York 17, N. Y. Price, \$5.

This is the first complete safety manual designed specifically for die-casting plants. Its purpose is to present proved and workable methods for the prevention of accidents and injuries in all departments, operations, and processes of a typical die-casting plant.

The manual was written by die-casters who specialize in safety procedures, and is intended primarily for small and medium-sized plants. The book is profusely illustrated and contains many prints of safety devices, control forms, and reference data. Included in the appendix is a list of safety organizations, as well as text-books and other literature on the subject. The book should serve as a valuable guide to safety engineers, as well as to plant superintendents, production managers, supervisors, shop foremen, etc.

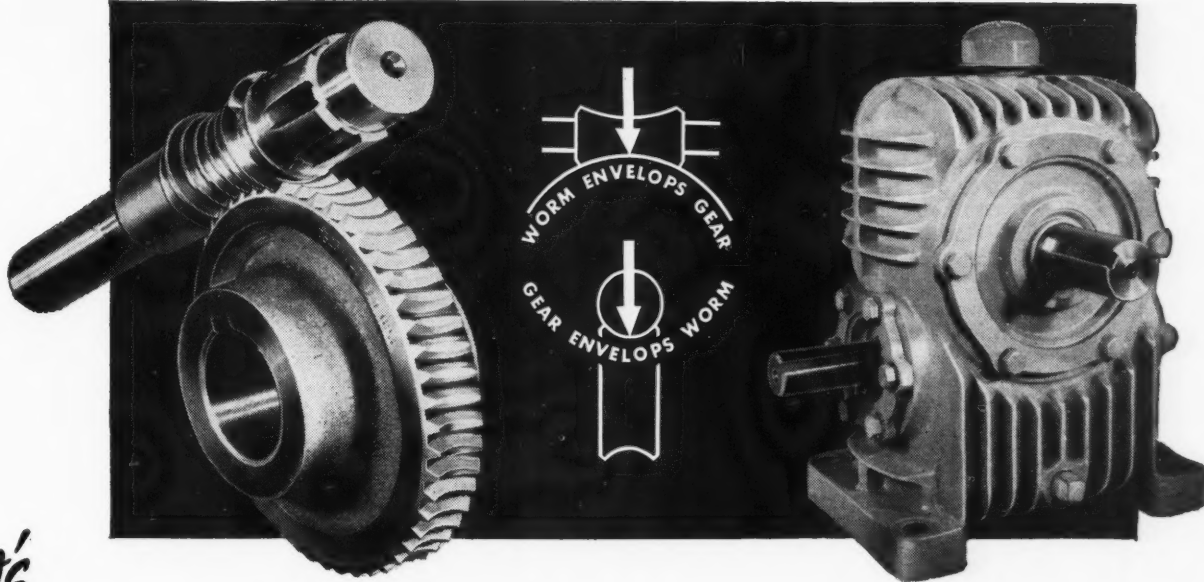
**MATERIALS BUYING MANUAL.** By Harold A. Knight. 340 pages, 5 1/2 by 8 1/2 inches. Published by Conover-Mast Publications, Inc., 205 E. 42nd St., New York 17, N. Y. Price, \$4.50.

In these days when scarcity of materials due to defense requirements frequently makes it necessary to seek substitutes, a comprehensive materials guide is of particular value. This buying manual contains basic facts on the great majority of commodities used in industry. Each material is defined, and information is given on the available grades or forms, principal uses, and, in some cases, price range.

Besides serving as a guide for purchasing agents, the book is intended to be of value as a reference source to materials engineers, presidents of companies, methods engineers, plant superintendents, and, in fact, all executives who are concerned with some phase of manufacturing or servicing—from the ordering of raw materials to the final shipment of the finished goods.

**CASTING AND FORMING PROCESSES IN MANUFACTURING.** By James S. Campbell, Jr. 536 pages, 6 by 9 inches. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, \$5.

The purpose of this book is to cover as completely as possible all the casting processes, plastics molding and forming, powder metallurgy, rolling, forging, sheet-metal working and punch press operations. While written principally for mechanical engineering students, the book should prove suitable for all branches of engineering. In the treatment, spe-



# That's right—"hydraulically smooth" gears!

## What we mean by "hydraulically smooth"

It used to be thought that carbide-tipped milling cutters on milling machines had to be protected against carbide-damaging gear vibrations in the cutter drive by using large flywheels at the cutter double. When Cone-Drive double-enveloping gears were tried, their 'hydraulic smoothness' made the flywheels unnecessary.

Never heard of gears that are hydraulically smooth? Then you should try Cone-Drive DOUBLE-ENVELOPING gearing: In Cone-Drive gears, the pinion or worm is wrapped around the gear and the gear is wrapped around the worm in such a manner that

**regardless of number of teeth, gear size or ratio,  $\frac{1}{8}$  of all gear teeth are in CONTINUOUS CONTACT.**

What is more, they are in continuous FULL DEPTH area contact. As a result, not only is power transmitted in a smooth uninterrupted flow AROUND THE CIRCUMFERENCE of the enveloped gear, but the load capacity for a gear set of any given center distance is greatly increased.

That means longer, trouble-free service, and the ability to use smaller gears to transmit a given load. As a matter of fact, Cone-Drive double-enveloping gears are so compact that many designers find they can simply

**replace costly built-in gear trains with complete standardized Cone-Drive speed reducers**

If you are looking for gears or reducers that will give you real hydraulic smoothness, greater load carrying capacity in a limited space, and a simpler gearing installation, fill in the coupon, attach to your company letterhead and mail it today.

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Please send me without obligation further information on double-enveloping Cone-Drive Gears. We are particularly interested in the following:

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**CONE-DRIVE GEARS**

DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS

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cial emphasis has been placed on both design and modern mass production viewpoints.

The subjects covered include making a simple mold; patternmaking; molding materials and equipment; molding techniques; pattern equipment; molding machines; cores and coremaking; metals for sand casting; melting; cleaning and finishing; inspection; sand-casting design; centrifugal casting; precision investment casting; permanent-mold casting; die-casting; molding and forming plastics; powder metallurgy; rolling; forging; sheet-metal working; and punch press work.

**DIE-CASTING DIES (Part 3).** 63 pages, 5 1/2 by 8 1/4 inches. Published by the Machinery Publishing Co., Ltd., National House, West St., Brighton 1, England. Sold in the United States by THE INDUSTRIAL PRESS, 148 Lafayette St., New York 13, N. Y. Price, 75 cents.

This new addition to the Yellow Back Series, No. 4E, is a companion volume to Nos. 4A and 4D on the general subject of die-casting dies. The present book describes a number of safety devices designed to insure the safe operation of the die in the machine, including those that insure correct operation when the die closes; devices designed to prevent injection of molten metal when the die elements are not in the proper position and to prevent the dies from opening during metal injection; and safety devices related to core operation. In addition, some useful information is presented on core-operating mechanisms and the employment of collapsible cores.

**AMERICAN STANDARD TOLERANCES FOR BALL AND ROLLER BEARINGS (B3.5-1951).** 19 pages, 8 1/2 by 11 inches. Published by the American Standards Association, Inc., 70 E. 45th St., New York 17, N. Y. Price, 75 cents.

**PLANT LAY-OUT—PLANNING AND PRACTICE.** By Randolph W. Mallick and Armand T. Gaudreau. 391 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, \$7.50.

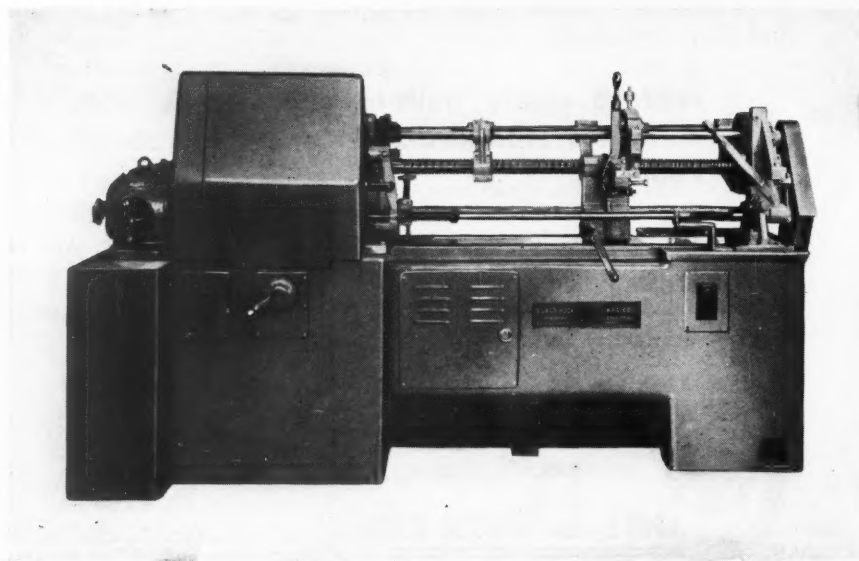
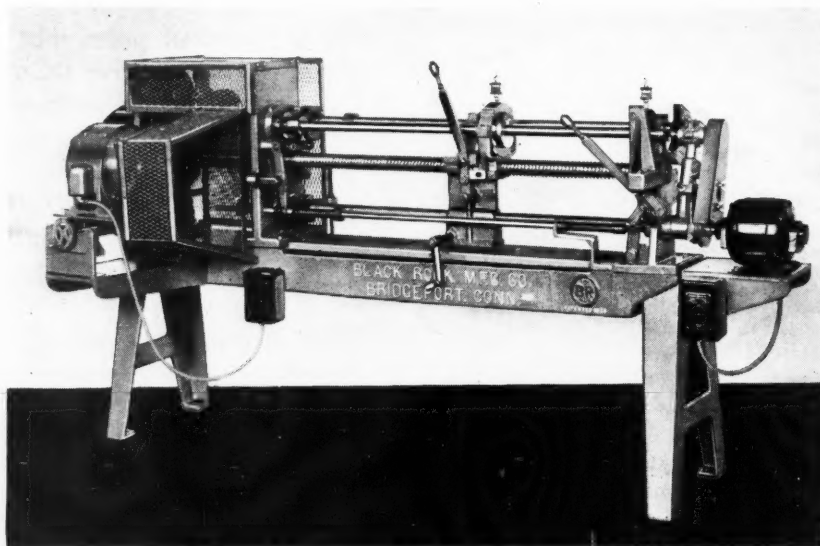
Complete engineering techniques for laying out entire plants and modernizing existing lay-outs are presented in this book, which was developed to serve as a guide for engineers and as a reference work for engineering colleges and schools of business administration.

The principles and practice of planning, designing, and presenting plant lay-out projects are discussed, including the designing of production and assembly lines, receiving, shipping and storage areas, dispatch stations and tool-rooms, material-handling systems, service facilities and office space. Particular emphasis is laid on conservation of space, profitable use of plant services, and scientific analysis of material-handling. Capital outlays, operating costs, and projected savings are evaluated.

**DESIGN OF MACHINE MEMBERS.** By Alex. Vallance and Venton Levy Doughtie. 500 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, \$6.

Now appearing in its third edition, this book on the design of machine members has been prepared for the use of students who have had some training in kinematics, mechanics, and factory processes. Using these subjects as a foundation, an explanation is given of the theory involved in the design of the elements of operating machines and the variations from theory required by practical applications.

All the chapters have been revised and in many cases rewritten in order to bring the material completely up to date. New material is provided in the chapters dealing with stresses, riveted joints, threaded fasteners, power screws, gears and hoists, and power chains. The presentation of such subjects as endurance limit, eccentric loading, columns, structural riveting, etc., has also been expanded.



Original (above) and redesigned (left) versions of a rubber cutting machine made by the Black Rock Mfg. Co., Bridgeport, Conn. The original machine required seven castings and a considerable amount of machining, and its bolted structure lacked rigidity, adequate drainage facilities, and versatility of design to meet various requirements. These shortcomings were eliminated and the appearance of the machine greatly improved by changing to a welded design. Also, substantial savings resulted from the reduction in machining and finishing operations.—Photos courtesy of the Lincoln Electric Co.